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THE VALUE OF BLOOD PRESSURE DETERMINATIONS IN MAJOR SURGERY*

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Although it has been 79 years since Poiseuille introduced the U-tube mercurial manometer, and although 29 years have elapsed since Riva Rocci made his very important determinations on blood-pressure, which led to its widespread use in general medicine, it has only been during the last few years that its value in general surgery has been recognized.

TECHNIC

Even though it is true that if one has had a large experience in palpating the pulse, he will necessarily make fewer mistakes than would be made by the inexperienced observer; still, it is impossible for any one to estimate blood-pressure in this way as accurately as can be done by the sphygmomanometer.

An ordinary flat stethoscope bell is strapped firmly, but not too tightly, over the brachial artery just above the elbow, and the blood pressure cuff is fastened tightly and smoothly on the upper arm. Before starting the anesthetic, the systolic, diastolic and pulse pressures are determined both by auscultation and palpation, and the relation between the first oscillations of the pointer and the systolic as determined by ausculation is noted. The pulse can be counted with the stethoscope, as the pressure is being released to get the diastolic pressure, and the whole procedure need not occupy over two or three minutes time.

It is important to get the pressure by palpation and notice the first oscillations of the pointer, because the cuff may slip on a very fat arm or the sounds might become faint, and then the pressures can be obtained by palpating the pulse when the arm is placed on a table; or, if this is not done, the pressures can be partially judged by noting the movements of the pointer.

If possible, the arms should be extended by the side, preferably with the wrists fastened to cuffs on the table, for, in a heavy patient, if the hands are placed under the hips, as it is frequently done, the accuracy of the readings may be interferred with, and besides, if this position is maintained for from 1½ to 2 hours, it might cause pain in the hands and wrists for several days after the operation. If, because of the nature of the operation, the arms have to be placed upon the chest, the readings obtained in this position will be found to be 10 to 20 mm. below those obtained when the arms are extended, so naturally this must be thought of the moment the change is made.

INTERPRETATION OF READINGS

There are a few well-known general principles that should be emphasized. *First,* the blood-pressure depends primarily upon the force of the cardiac contractions; in other words, the heart is the pump. *Second,* because of the elasticity of the great arteries they are able to distend and take care of the additional amount of blood that is sent from the heart with each contraction. *Third,* the arteries are so-called shut-off valves, since they determine the amount of blood that will pass through a certain group of capillaries, hence, control peripheral resistance. *Fourth,* the capillaries and veins return blood to the right auricle by means of muscular contractions, gravity, and suction by the heart and lungs.

From a study of these well known principles, one can readily see that the pulse pressure concerns the heart only, since it is the working pressure in moving the blood. Because of this fact, it is the most important single blood-pressure guide to the power of the heart. It has been shown that the urinary secretion is directly dependent upon the pulse pressure, and any pulse pressure below 20 mm. will give cause for alarm as there may not be sufficient pressure to force enough blood through the kidney to permit kidney secretion.

The systolic pressure will be more variable than the diastolic, because the systolic has to follow the variations in the heart rate.

Since these variations in heart rate are constantly occuring from many factors incidental to the operation and the anesthetic, it can readily be seen that the systolic pressure alone is not as valuable a sign of shock as was formerly supposed. The heart must maintain a certain pressure in the aorta, so that sufficient blood can go through the coronary arteries to give proper nourishment to the heart muscle. When the pressures are falling, the heart tries to compensate by increasing the output, this usually means by increasing the heart rate.

I have noticed clinically that with a good heart muscle there is always a tendency for the blood-pressure to rise as soon as the pulse rate increases, and this can be kept up as long as the heart muscle can compensate. This length of time will vary with the depth of the anesthesia—a deep anesthetic shortening the period of compensation—and with whether the shock producing factors incidental to the operation, such as loss of blood and rough handling of tissues are allowed to continue.

With the elderly patient or the one with a badly compensated circulatory system, the pressures nearly always begin to fall from 10 to 20 minutes before the pulse rate begins to markedly increase, while in the younger person, or the person at any age, whose

*Read before the Section on Surgery, State Medical Association of Texas, Austin, May 7, 1925. Courtesy Texas State Journal of Medicine.

heart and blood-vessels can compensate for the different depressive factors that are present in all long major operations, the pulse rate begins to increase at about the same time that the pressures start to decline. In either case, if the shock-producing factors are stopped soon after their effect is felt, the pulse rate will begin to decrease and the pressures will start to rise to their original level.

While it is true that solutions given intravenously or in the subcutaneous tissues will help to maintain the pulse rate and blood-pressure at more nearly a normal level than if they were not used, still, the cessation of the harmful influences will act in a much quicker and more permanent way than will anything else.

Herein lies the great importance of frequent blood-pressure determinations throughout the operation, since not only can the approach of shock and loss of blood be seen from 5 to 20 minutes sooner than by any other method, but the proper remedial measures can be regulated in a more accurate way, and the anesthetist can give the surgeon more percise information than by merely saying that the pulse is weak or of poor volume.

It has likewise been shown that during exhalation the intrapulmonary pressure is increased, thus aiding the heart to force the blood out of the chest, so that the systolic pressure is from 5 to 10 mm. higher during exhalation than during inhalation. It can readily be seen that with a greatly increased respiratory rate this help will not be afforded the heart. Sufficient morphin before the operation does great service in this respect.

If the air way becomes obstructed from any cause, not only will the right heart be working under a great strain, but the left heart will be deprived of the assistance that is normally given to it by the increased intrapulmonary pressure caused by exhalation. Hence, it is bad practice to allow a patient to go through a long operation with an air way that is partially blocked by a relaxed tongue, masseteric spasm, or inadequate nasal breathing, when an artificial air way by mouth, or rubber catheter in the nose will relieve the condition.

These statements show that the respiration plays such a valuable rôle in relation to the whole picture that the relations of the pulse, the systolic, diastolic and pulse pressures, and the respiratory rate and volume, must be studied as a whole, and the relationship that exists at any one time can only be told by a graphic record that will tell at a glance just what the entire picture presents.

Influence of Position and Operative Procedure

The position of the patient on the table influences the blood-pressure to a marked degree. Miller, in a series of 1,000 cases, found that the blood-pressure was influenced very little by the dorsal position. There was an increase in both the systolic and diastolic pressures in the combined lithotomy and Trendelenburg positions in 50 per cent. of cases, and usually an increase in the lithotomy position alone. There was a lowering of systolic and diastolic pressures in 57 per cent. of cases when the Trendelenburg was used, and a marked lowering when the Fowler or reverse Trendelenburg was employed. These latter two results plainly show that the Trendelenburg must be used with caution and the position assumed or changed very slowly so as to give the heart and blood vessels a chance to accommodate themselves to the different position.

I have seen a death occur four hours after the operation, when a patient in fairly good condition, was placed in the Fowler position as soon as she was returned to bed. This position, except in very exceptional cases, should never be used unless the patient has nearly regained consciousness.

It was brought out during the War by a commission appointed to study conditions of shock, that change of position after the patient was well under the anesthetic always tended to lower the blood-pressure and therefore, it was advised to do the most extensive work in the first position assumed, rather than doing the most shocking operation after considerable work had been done in a previous position.

I have noticed the same results that were brought out by Miller, and in two cases noted the circulatory depression suggested by the commission. These cases were ones in which the lateral posture for kidney surgery was first assumed, followed by the dorsal position for abdominal work.

Preoperative Prognosis Based Upon Blood-Pressure

If possible, one must have one or more pre-operative blood-pressure readings, as quite often the one obtained just before the anesthetic is started, gives a false picture, as fear and apprehension are capable of raising the systolic pressure 20 to 50 mm., while in some patients, morphin will lower the systolic in just the same proportion. However, even in these extreme cases, the diastolic is affected very little, and by obtaining the pulse pressure before the anesthetic and again 10 to 15 minutes after the anesthetic has been in progress, one can arrive at fairly accurate conclusions as to the real pre-anesthetic readings.

I much prefer to see a fairly high systolic with a comparatively high diastolic than a moderately low systolic with a small pulse pressure, but prefer the latter condition to one in which the systolic and diastolic are both very high with a comparatively small pulse pressure. Generally speaking, any case with a diastolic of 120 mm. or over, regardless of the systolic, does not present a picture that is favorable to a long deep anesthetic or severe operative trauma, because the heart is already laboring under

a heavy strain, in constantly having to overcome this high pressure each time the aortic valves are opened for the additional amount of blood to be thrown into the arterial system.

One of the hardest cases to interpret is the one in which the pulse is very slow and the pressures correspondingly low. I have noticed that these cases withstand shock much better than extremely high pressure cases, provided the pulse pressure is fairly good.

SHOCK

The mere fact that many theories have been advanced as to the cause of shock and its exact nature, would convince any one that the question has not been definitely settled. However, low blood-pressure is the most distinctive and the most constant evidence of the shocked condition. It is believed that this state of low-pressure depends upon a reduction of blood volume in active circulation, and that capillary stagnation probably accounts for the reduction.

Gruber has shown that when the systolic pressure is below 90 mm., the muscles become less capable of work, as contractile organs, and the whole central nervous system shares in an impaired nutrition secondary to the low blood pressure. Because of this lack or reduction of the contractile power of the muscles, I believe that capillary stagnation could easily follow and a vicious circle result.

CONCLUSIONS

The keeping of routine blood-pressure records in major surgery will convince any one of the following facts:

1. Contrary to the general belief, surgery from the start, tends to lower the blood-pressure, and this depression in the average handicapped patient coming for operation, begins from 5 to 20 minutes prior to any other symptom indicative of the approaching shocked state. The use of several large abdominal packs, unless they are packed with great care, will cause a temporary drop in the systolic and diastolic pressures; and, if the packs are cold, the degree of drop is greater. Rough handling of the tissues and the intestines always markedly reduces the pressures and increases the pulse rate. Loss of blood, unless the quantity is very small, always lowers the pressures and afterwards increases the pulse rate.

2. All three general anesthetics now in use, ether, nitrous oxid-oxygen, and ethylene-oxygen, cause a rise of blood-pressure, during the first 15 minutes, the greatest rise occurring with nitrous oxid. The next with ethylene, and least with ether. But greater depression is seen with ether than obtains with the other two, and a deep ether anesthetic continued for over one hour in any patient, except the young adult of good cardiac compensation, nearly always causes a distinct drop in both systolic and diastolic pressures and a well recognized increase in the pulse rate.

It is true that ether is a so-called cardiac stimulant, but this is not the case when the amount is used that is necessary to produce complete and absolute relaxation. Ethylene seems to produce more gradual changes in the pulse, respiration, systolic and diastolic pressures than nitrous oxid and is not as depressive as ether.

Spinal anesthesia nearly always produces such an extreme drop in blood-pressure that it is contraindicated in low pressure cases, and novocain, in some patients (particularly those of the nervous type) produces a distinct drop in pressure, and is not devoid of harm when used in large amounts as a local anesthetic.

3. Such extremely valuable information may be obtained by routine charting of the pulse, respiration and the systolic and diastolic pressures, that it is to be hoped that the procedure may be given a fair trial. If this is done, it will be agreed that this step, taken in conjunction with careful inspection of the patient as regards capillary circulation, depth of anesthesia, color, etc., will enable the patient to pass through the anesthetic and operation with the knowledge that everything possible has been done to safeguard this most perilous journey.

804 E. EUCLID AVE.

Local Anesthesia in Dislocation of the Hip. O. WIEDHOFF. *Zentrallblatt für Chirurgie*, 52, 454, 1925.

The reduction of dislocations of the hip-joint under local anesthesia induced by injection of the anesthetic into the acetabulum and around the head of the femur, has the defect that, although reflex spasm is got rid of, the normal muscular tonus persists. It is necessary, in order to effect a reduction with facility, not only to render the bones insensitive, but also completely to remove the tonus of the muscles attached to the upper end of the femur. For this purpose it is insufficient to anesthetize the four great nerves passing to the lower limb; this would leave the pelvis sensitive, and some of the muscles, more particularly the ileopsoas, would retain their tonus. Wiedhopf found the following procedure satisfactory: he injected 5 c.cm. of a 1 per cent. solution of tutocain (with the addition of 20 drops of a 1 in 1,000 solution of adrenalin to 100 c.cm.) into the first four lumbar segments, paravertebrally on the affected side, and anesthetized the sciatic nerve at its exit from the pelvis with 25 c.cm. of the same solution. The usual directions for reaching the nerve require slight alteration owing to the displacement of the parts; retaining the usual vertical line from the posterior superior iliac spine to the outer edge of the ischial tuberosity, Wiedhopf recommends that the horizontal line be taken from the upper end of the anal furrow, this being sufficiently accurate. Injection of the obturator nerve is unnecessary. The lumbar injections anesthetize the pelvis and relax the ileopsoas and the muscles supplied by the anterior crural and obturator nerves; the injection of the sciatic nerve anesthetizes the femur and the flexors of the thigh, as well as the gluteus maximus; and the other gluteal muscles are probably influenced to some extent through diffusion of the anesthetic. The author mentions two cases in which the dislocation was reduced with ease by this method. Shortly after the injections all pain ceased, the muscles relaxed, and, after waiting a quarter of an hour, reposition was effected painlessly and without difficulty.

PERFECTING DETAILS OF ANESTHETIC SERVICE*

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Let me preface my remarks with two quotations:—"We may say what we please about *'Third molar specialists'* and gynecology as a separate branch of surgery, but there does seem ample ground for approval of the classification *'Specialist in Anesthesia,'* " (*The Literary Digest*, September 26, 1925).

"We have never considered the value of surgical organization in our clinic without being at once impressed with the value and need of the trained and experienced anesthetist who devotes his thought and interest solely to this field," ("The Value of Organized Surgery to the Poor Surgical Risk" by Frank H. Lahey, M.D., *Journal of the American Medical Association*, September 19, 1925).

The thoughts expressed by the writers just quoted are very gratifying to those of us who have been in the front ranks and have been fighting for the protection of those who were compelled to take an anesthetic.

Our aspirations as specialists may be summed up in the mottoes of the Pacific Coast and Canadian Anesthetists—*"It is God-like to Relieve Pain,"* and *"We Safeguard Those Who Sleep."*

BETTER SERVICE—THE HERITAGE OF ANESTHESIA

Facing the problems of the present and the responsibilities of the future, what can we do with our heritage of anesthesia to make it meet the needs of suffering humanity. *Better Service* is the world's slogan of progress and *Better Service* is our own challenge today.

The time is past when surgeons and hospitals can any longer neglect the anesthetic service their patients receive, and the surgeons and hospitals that provide expert medical anesthesia will move forward with such rapid strides that the reluctant ones will be forced to follow or fall by the wayside.

The hope that nature will heal, the horror of operation, and the fear of anesthesia still keep many patients from accepting surgery until their condition makes intervention all the more a hazard. Then, all to often, they are looked upon as *supposedly fit*, operated without being inventoried and become the tragedies of the operating room and surgical wards. Their needless and preventable deaths are a blot on the shield of the Fourth Era of Surgery and make the public more pessimistic and panicky. The public fully realizes that it is the patient and not the surgeon who takes the risk; a life against a reputation. The knife may compel patients to put one foot in the grave; the anesthetic certainly does.

As an Association what can be done?

First: We must insist that medical students receive adequate anesthetic education in their colleges, and that their instruction in this important branch of medical science be not left until after graduation when they are serving their internships. It is an outstanding disgrace to the medical profession that such anesthesia training as medical students may receive is often obtained from a nurse.

Second: We must insist that every hospital doing surgical work shall have a medical anesthetist on the staff.

Anesthetic service means more than the administration of an anesthetic at the time of operation; it means preoperative examination and treatment, watchful care during the operation, and postoperative attention. This means that the anesthetist of the present and future must be an all around top-notch doctor, and aside from proficiency in the science and practice of anesthesia, must keep abreast of all the advances and resources of general medical progress, that can be used for the benefit of operative patients.

It is the duty every anesthetist owes himself to go out to available sources of information and inspiration. Our congresses with their post-graduate research sessions, our regional meetings with their practical clinics, our Journal and Supplement with their endless contributions, are all sources of information and inspiration.

The basic science of anesthesia is almost a life's work, but it can be accumulated and collected for use by systematic and persistent effort. Our Research Society is being very helpful in this respect and will be even more so in the future. We, as anesthetists, must be prepared to do our work, as have all the giants of medicine in the past, at the bedside, in the clinic, at the operating table, never for a moment forgetting that we are dealing with life itself.

EVALUATING ANESTHETIC RISK

Why should the anesthetist examine the patient before operation when this has already been done by the surgeon? Simply because, no matter how thoroughly the surgeon has examined the patient and how accurate his diagnosis, he cannot relay such information, and many of the surgeons are asking the anesthetists to see the bad risk patients before operation. How frequently we hear: "Will you see such and such a patient? I will operate if you can carry the patient through the anesthetic." That is putting the question squarely up to the anesthetist; that is a challenge both to our knowledge

*Read during the Joint Meeting of the Eastern and Mid-Western Anesthetists with the American Association for Regional Anesthesia and Academy of Stomatology, Hotel Adelphia, Philadelphia, October 26-30, 1925.

and skill; knowledge as to what the patient can withstand, and skill in handling the situation so the surgeon can do his work well, with as little harm to the patient as possible.

We must go over the patient's history, the laboratory reports, and acquaint ourselves with the surgical diagnosis and operation intended, and know approximately how long it will take. Those of us who are working with several surgeons must take into consideration their speed as operators, and whether they are rough or gentle in their manipulations; for it is a fact that slow but gentle operators will do less harm than those who are speedy but rough. I have heard one surgeon say that if he could complete an operation in forty minutes his patients did not have so much shock, and he devoted his efforts to making record time and the treatment of shock. His motto seemed to be: "How much work can I do?" not: "How much good can I do?" The word shock covers a multitude of sins, and our efforts should be exerted to prevent shock, not treat it.

PREOPERATIVE PRECAUTIONS

The methods frequently employed in the operation of the patient, such as purgation, starvation, and withholding fluids for hours before operation, place the patient in an ideal condition for a stormy convalesence if death itself is not the result.

Nausea, vomiting and the pains from the distention of the intestinal tract can be eliminated by proper premedication. If the patient is given alkalies until the urine is alkaline to methyl red and this condition is maintained before and after operation and a sufficient carbohydrate intake provided, the patient will not vomit or be nauseated, except as a result of the action of morphin if there is an idiosyncrasy for it.

The patient, who has been given a laxative long enough before operation to allow the intestinal tract to recover, will, if the operator handles the intestines carefully, have very little if any trouble with gas pains. The administration of glucose before operation will be of great benefit in building up a reserve and will place the patient in a better condition to withstand the necessary trauma and shock of the operation and anesthetic.

We should look carefully for any acute infections of the respiratory tract, and, if evidence of trouble is found, postpone the operation until recovery, and thus prevent many of the so-called ether or anesthetic pneumonias. Mouth hygiene should not be forgotten, and everyone knows that infected teeth should be removed before the patient is subjected to an operation. With the patient on the table ready for the anesthetic, an inspection of the mouth frequently reveals the fact that someone has slipped. May not this account for some of the infections in otherwise clean cases?

Take the blood pressure before operation, note the diastolic and systolic pressure and pulse rate; have the patient hold the breath for thirty seconds and note the diastolic and systolic pressure and pulse rate. If comparison, after the breath taking test, shows a rise in systolic pressure it denotes cardiac reserve, and if a fall, the lack of it. Forewarned is forearmed.

A peculiar sound of the heart and an unduly rapid pulse may lead to the discovery of a hitherto unsuspected toxic thyroid. It is a good plan for the anesthetist to do his own metabolic work as it will give him a better understanding of the condition of the patient. During the examination the patient and anesthetist become acquainted, it affords an opportunity to ask questions, and the patient goes to the operating table quiet and confident that his welfare is being cared for.

When we administer an anesthetic we are giving an agent that will deprive the patient of his senses since the only centers that are active are those governing the heart and lungs, and these may become so depressed that they cease to function. Literally we have the patient's life in our hands. This being the case we are in duty bound to know all there is to know of the action of the agents we are using, the danger symptoms, and methods of resuscitation in the event of accident.

A. E. Guedel has interpreted for us the eye signs and A. H. Miller the respiratory signs of anesthesia, and a study of their work will be of great benefit to us. If we heed what they say and then keep an open airway, about the only difficulty we will encounter is from the heart, and E. I. McKesson has been talking for years about the use of the sphygmomanometer as a means of determining cardiac efficiency. The taking of blood pressure during operation means that we have an advanced warning of impending danger, and he who does not give his patient the benefit of this knowledge is neglecting one of the most important means at his command to prevent accident and to conserve life.

Records play an important part because all concerned can be shown that life and death can be charted, and these records are the invaluable basis for future study and report.

THE NURSING PHASE OF ANESTHESIA

There is a place for nursing in relation to anesthesia and in endeavoring to perfect my anesthetic service I have employed a registered nurse, whose duty it is to have blood-pressure outfit applied, charts and anesthetic apparatus in readiness, and during the operation to help keep the charts and be available in the event anything else is needed. Being in my employ she does not have to attend to the wants of anyone else. Near the close of

the operation, when the next patient is brought to the anesthetizing room, she places a duplicate blood pressure outfit on the patient, sees that the necessary charts are ready and that the apparatus is sterilized and in place, then I turn the operated patient over to her to accompany to the room and to see that the nurse in charge has everything that is needed at hand so that it will not be necessary for her to leave the patient until he is fully recovered. I can then proceed with the next patient, and in this way can conserve both my time and the time of the operator, as it is possible to make a complete change in a few minutes, and on a busy day this means a saving of from one to two hours.

Before placing a nurse on this work, the surgeons and operating room nurse were complaining about the loss of time. As one person said, "Life was too short to waste with such things." I feel that the proper administration of the anesthetic means so much to the patient both as to the immediate safety and during convalesence that I am repaid for the added care and attention.

After-Care

I feel that the anesthetist's duty to his patient does not end when the mask is removed from the face. Who of the surgical team is in a better position than the anesthetist to suggest the after-care; I do not mean the dressing of the wound and surgical attention but a thorough familiarity with the newer phases of cardiology, blood and tissue chemistry and tests for functional organic activity and reserve, metabolism and endocrinology, spirography and vital capacity.

But diagnosis and prognosis are not enough. All the resources of up-to-the-minute therapeutics must be coralled—digitalization, transfusion, insulin-glucose, mineralization, glandular therapy, vaccines—in fact everything that the College of Physicians is adding to the practice of medicine.

I visit every patient on the day of the operation before leaving the hospital, and frequently that is after the surgeon has left. If there is anything that the surgeon should know I have the nurse in attendance notify him or do it myself. Frequent calls are made on all patients during their stay in the hospital. This enables me to note postanesthetic complications, affords opportunity to spread the gospel of better anesthesia, and I have spent much time in discussing anesthetic questions with them.

The Cruelty of Surgery

There is one remaining cruelty of surgery. All patients have an anesthetic for their formal operations—but today in the office, the clinic, in industrial and emergency surgery, and in the hospital, after operation all sorts of agonizingly painful things are done to patients in the way of minor procedures and dressings, that could be done painlessly if only those concerned were thoughtful enough to call in the anesthetist.

To meet the demand for better service, we as specialists in anesthesia must be prepared and willing to give always this preoperative examination and treatment, this watchful care during operation, and this postoperative attention,—in a word—anesthesia, instead of being the last straw becomes in reality the salvation of the patient.

37 S. Williams St.

The Poor Risk for Surgery of the Pelvic Organs. John G. Clarke, Philadelphia, *Journal A. M. A.*, September 19, 1925.

Clarke says that experience teaches that it is the preliminary study and adequate preparation of patients for an operation; the employment of a first class anesthetist, and the shielding of the unconscious patient from avoidable risks that are the combined factors which have reduced some of the grave contraindications of other years to the rank of lesser dangers, and have removed others from this list entirely. Experience has taught that the surgical novice, and all too frequently the more experienced surgeon, regards the human body as an assembled mechanism, which requires only the adjustment or repair of this or that compotent organ in order to make the whole function properly, little or no regard being paid to that more or less occult psychic or nervous influence which to the best of surgeons and physicians is ill defined, and yet is of such potent value in the well adjusted recovery of a patient. Unfortunately, no instrument will give an estimate of the potency of this vital factor, as the electrometer will test the strength of a storage battery, and one is forced to fall back on much cruder methods for the calculation of this essential biologic force. Because of the lack of scientific methods of measurement, its estimation falls more within the range of the intuition of the physician or surgeon, or, perhaps better stated, must rest on his good judgment as to the vital resistance and nervous stability of the patient. A large percentage of medical and surgical cases fall more or less among the so-called neurasthenic group. Some patients have actual and definable equilibrium, and it is, therefore, acquired; others are the victims of apprehension while in a large proportion the mechanism for the production of vital force is congenitally deficient. The human body may be well constructed so far as any ascertainable fault in any organ is concerned, and yet under unusual stress its vital force fails, just as the power of an automobile ebbs when its batteries are rendered inefficient through use or are deficient from the start. The first battery may be repaired, but the second, until replaced by a more powerful one, will never serve except under light demand. Symptoms directly referable to a given organic lesion may be cured, but the neurotic stigmas, just as the leper's spots, are not effaced. As the surgeon of experience observes this intensive research for toxic foci, he is likely to conclude that it is merely a variant from the old theory that gastric symptoms were often reflex manifestations of pelvic lesions, a delusion that has been dispelled by the progress of surgery in the upper abdomen. A toxic obsession may have replaced that of the reflex hunter, but out of this intensive search for the cause of many ill defined symptoms limited good will come, as it always does, with the passing of medical fads; but the violence of such a flood tide will leave many derelicts in its wake.

THE ANESTHESIA DEPARTMENT OF A HOSPITAL*

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TERRE HAUTE, IND.

Every hospital has a reputation whether it be good, bad or blended. What determines this reputation? Is it the imposing building and the elaborate equipment; is it the training school and its efficient nursing; is it the dietitian and her appetizing trays; is it the *esprit de corps*, the wholesome and encouraging atmosphere of the place? Whatever it is, for the purpose of this paper, it is the *anesthesia department*.

Time and time again you hear prospective patients say, "I don't want to go to the hospital because I am afraid of the anesthetic. I don't dread the operation, but I don't want to be strangled into insensibility by the ether. I don't want the surgeon to start until I am asleep, and I want to be sure that I wake up." Bad news travels quickly, and this too prevalent opinion condemns all hospitals because of the barbarous methods still in vogue in some hospitals.

NURSING ANESTHESIA—AN ABUSE

True, anesthesia has not been a recognized specialty for very long, but it is well enough established now to merit its place as a distinct department in every hospital worthy of the name. The previously mentioned ill repute of anesthesia will be eradicated only when the department is so developed that it can operate in accordance with recently accepted methods. Well regulated institutions will not permit incompetent and untrained surgeons to use their operating rooms. The reputation of the hospital is just as much jeopardized by allowing the doctor who sends in the case to give the anesthetic. Naturally his interest is in the surgical operation to the neglect of the finer points in the art and science of anesthesia. He locates the plane of anesthesia about as follows: pour until the patient is quiet; watch operation until he moves or groans; pour until he is quiet, and so forth.

Now, it is apparent that this phase of the problem is best solved by the surgeon, who can insist on having his own surgical team for the work. When it comes, however, to the other abuse, that of nursing anesthesia, the hospital administration itself decides for or against the practice. I cannot believe that a hospital is actuated by any but mercenary motives when it hires a nurse to give anesthetics on a salary and collects the fees for her services at the usual rate. The nurse, while paid as well as the other graduates on the staff, will actually receive less than $2.00 per anesthetic; the hospital pockets the remaining amount.

Such exploitation is venal notwithstanding all the specious arguments advanced by its protagonists. The very fact that some surgeon agrees to accept the responsibility and have the nurse give the anesthetic according to his instructions, evidences the accepted inferiority. Any anesthetist will tell you that the period of induction is the period of greater danger. Where is the surgeon then? In the operating room directing the anesthesia? No, he is either finishing another operation or scrubbing his hands for this one.

I am not overlooking some nurses I know who give bettter anesthetics than some of the doctors but I am also convinced that some surgical nurses could do a clean appendectomy with better technic and in less time than a number of general practitioners who do their own surgery. Aware of this technical ability, first aid nurses in factories are suturing wounds and opening abscesses. In both instances, the nurse anesthetist and the nurse first aid surgeon know the rules of practice, but only the physician by means of his larger and more thorough training knows the exceptions to the rules, and when the best interests of the patient demand a violation of the set rules.

Certain nurses possess gentleness, tact, patience, tireless attention to detail and a love for the special work, all ingredients of a good anesthetist. Certain physicians have all these and by reason of their more advanced instruction in physiology, pathology and pharmacology add to them a self-reliance, a judgment of the kind and depth of the narcosis best adapted to the particular patient and a masterful poise in times of peril.

If you or a member of your family should come to the operating table tomorrow, which one will you choose? It is then the duty of the hospital, the staff and the public to offer to such physicians every opportunity for utilizing their talents. Surely with the present demand for graduate nurses in so many fields, she has no reason to seek new worlds to conquer.

DOCTOR'S AND NURSE'S WORK COMPLEMENTARY

Would you construe this as an insult to the intelligence and ability of the nursing profession? Nothing is further from my mind. I do not question the privilege nor the capability of a graduate nurse to pursue her studies further and become a graduate in medicine, but until she does that she is, and by all rights must be, circumscribed

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by the limitation of the term "nursing" profession. The two professions are co-equal in rank and dignity, and it is as unnecessary as it is dishonorable for one to invade the domain of the other. Let the nurse presume to perform duties belonging to the physician and she becomes an epicene being,—*i. e.*, of neither gender—and generally respected and treated as such. She loses her caste, receiving neither the honor due her as a nurse nor the standing in the community due a physician.

The Union Hospital of Terre Haute, Ind., since it began to work in eighteen ninety-two, has had an anesthesia department with a physician in charge, a specialist in anesthesia, responsible for its conduct, its records and its success. A rule was made that only a licensed physician or dentist could administer a general anesthetic except in an emergency. The hospital has no apology to make for this ruling, and believes that the results have justified it. If all the cards were turned face up before a surgical patient, we believe he would prefer to come to that kind of a hospital.

Minimum Standards

What should be the minimum standard for the anesthesia department?

A. *Equipment.*—There is no best anesthetic. Each operation and each patient requires a selection. There should be available:—

(1) Ether masks and small freshly opened cans of any recognized brand of ether for the open or drop method.

(2) Gas-oxygen apparatus as a preliminary to all ether in adults; for continued use in any case if so desired, but particularly for diabetics, septic and toxic cases and short operations such as radium implantation, dislocations, Colles fractures, incisions, thoracentesis.

(3) A closed ether machine, particularly for heavy, muscular men where abdominal relaxation is desired.

(4) Ethyl chlorid as a preliminary for ether in children. (Spray about 1½ c.c. on mask and allow a few respirations before starting the ether.)

(5) Chloroform may occasionally have a place, but the burden of proof for its indication rests heavily on the user.

(6) Local anesthesia either block, regional or infiltration is used in our hospital to the greatest advantage and with no jealousy on the part of the general anesthetist. He is sometimes called in to officiate in a mixed anesthesia, where colonic ether or gas is used as an adjunct to local.

(7) The anesthetist's table is no longer cluttered up with loaded hypodermics of digitalin, strychnia, camphorated oil. Shock is prevented rather than treated.

The tongue forceps is replaced by the pharyngeal tube the more frequent use of which is earnestly advocated. The presence of any degree of cyanosis is compromising to the patient.

B. *Rules for safeguarding the patient.*—Prevention is the keynote. Prevent psychic shock by avoiding catharsis or treatments which will interrupt sleep the night before. Give veronal at bedtime and morphin ¼ and atropin 1/150 gr. thirty minutes before operation, and above all demand a quiet demeanor in the operating room by those present. Prevent acidosis or lessened alkaline reserve by giving plenty of sugars plus soda bicarbonate the day before. Prevent pneumonia by having a warm operating room and heavy blankets for wrapping patients in when going back to the room. The term ether pneumonia should be replaced by the term exposure pneumonia. Prevent paralysis and backache by having a very thick soft pad on the operating table. Prevent anesthesia shock by all above plus a quiet induction and an evenly maintained anesthesia plane, as light as possible and varied only as the nature of the operation demands it. Use the blood pressure readings to warn the surgeon of impending surgical shock.

What Records Should Show

C. *Records.*—These need not duplicate the surgeon's record in showing the pre-operative condition of the patient, age, weight, heart, lungs, urine, blood pressure, habits and abnormalities. In all cases the pulse, respiration, the condition of pupils and of the eyeballs, the color of the skin should be charted at regular intervals. In serious cases the systolic and diastolic blood pressure should be included. The anesthetic agent used and amount, time for induction and maintenance, amount of excitement, ether tremor, degree of relaxation, the classification as a surgical risk and degree of shock present should be noted.

The final records available for tabulation at the end of stated periods should show the anesthetic mortality and morbidity. All too often anesthesia accidents are not reported but are concealed or camouflaged by the hospital.

D. *The last but most important desideratum is to have the department supervised by a physician (or more than one in case of larger hospitals), a specialist in anesthesia, who will administer most of the anesthetics.*

221 S. Sixth St.

NITROUS OXID-ACETYLENE-OXYGEN ANESTHESIA FOR EXTRACTION AND ORAL SURGERY*

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NITROGEN ANESTHESIA

For short anesthesias Nitrogen alone or with atmospheric air or with small percentages of oxygen may be used. The unconsciousness and insensibility to pain will last for a short period. "The anesthesia must be regarded as the result of oxygen deprivation, as it is difficult to assign any specific anesthetic properties to nitrogen itself." However, were there no better anesthetics available, it is probable that a technic would be developed for the use of nitrogen with oxygen for anesthesia. Nitrogen undergoes no chemical combination with any of the tissues of the body. The spectrum of hemoglobin saturated with nitrogen is the same as of hemoglobin alone.

NITROUS OXID ANESTHESIA

Our early experiences with nitrous oxid date back to 1910. Let us reconstruct the scene. Eight or nine gallons of gas are lead into the Long Apparatus from a tank. A large rubber bag is filled with the gas. The instruments, usually one or two forceps, are in a covered tray nearby. The patient is called in. A mouth prop is inserted The mask covering the mouth and nose is applied, assuring close adaptation and no leakage. Generally in less than a minute blueness of the ears and fingernails appears. There is just a snoring, then a marked rasping and stertor. If the administration is still continued—usually it is not—the patient's body may arch (opisthotonus). The patient is now, shall we say, deeply anesthetized or moderately asphyxiated. The operator stands ready with his forceps. He has learned to value every second.

The inhaler is removed with the left hand while the right hand deftly and speedily is applied to the first tooth to be extracted. The period of anesthesia lasts about 50 seconds, in which time one to ten teeth are generally extracted. It sounds unbelievable, but the success of the operator depended, in those days, upon his speed and gumption. If the patient came to before the operation was over the mask was re-applied, the patient re-cyanosed or re-asphyxiated.

In the files for the year 1848 of a New England Medical Journal, the curious may come across a report of the removal of a tumor, in which nitrous oxid anesthesia up to the point of asphyxia was applied for fifteen minutes, during which time the mask was applied, removed and re-applied a number of times. Many similar reports are scattered through medical journals.

Scientists are not in accord as to the action of nitrous oxid. Many have claimed that it has definite anesthetic effects. Others say that it acts merely through the reduction of oxygen in the body, that is, definitely as an asphyxiant.

NITROUS OXID-OXYGEN ANESTHESIA

In 1868 Andrews, of Chicago, administered nitrous oxid with oxygen for prolonged anesthesia. About a decade later Paul Bert, one of the world's most brilliant investigators, reported to the Academy of Sciences, Paris, that nitrous oxid with oxygen will not anesthetize. Many German and French writers have quoted Paul Bert during the last five years, overlooking the fact that nitrous oxid with oxygen has been extensively administered for over thirty years in the United States especially; and Paul Bert, himself, showed its possiblities under pressure.

Technic.—To help the reader develop a technic which will be best in his hands we will present those of McKesson and Heidbrink and then our own. As we have tried in our, not narrow experience, various methods, we consider our own the best—*in our hands.*

Heidbrink's Technic.—Set oxygen at 7% and nitrous oxid 93%. Apply nasal inhaler and mouth cover. Open stop cocks to both. Patient then may breathe the gases through the mouth as well as the nose. Instruct patient to interlock fingers, place hands in the lap, breathe naturally through the nose and go to sleep. At expiration of one minute administer nitrous oxid *alone,* until anesthesia is complete (usually 30 to 60 seconds). Normal adults will reach the operative stage of anethesia approximately 40 seconds after the oxygen has been discontinued. Rhythmic breathing and the disappearance of eyelid reflex indicate complete anesthesia.

McKesson's Secondary Saturation.—B.H. Harms, of Omaha, in a splendid article presents three methods to maintain a smooth, quiet anesthesia with nitrous oxid and oxygen. The first two, (1) preanesthetic medication and (2) synergistic anesthesia, he discards; and recommends (3) the McKesson method of secondary saturation. Nitrous oxid alone is given until signs of anesthesia appear, then add a small percentage of oxygen until the stage of profound anesthesia which is noted by all signs of an overdose—as prolonged expiration; phonation due to muscular spasm of vocal cords; wild-looking expression; tetanic spasm, marked rigidity, opisthotonus in some cases; and usually cyanosis. This profound stage is maintained only momentarily to secure complete or secondary saturation with nitrous oxid. At this point, it is necessary to give the patient two or three breaths of oxygen, or if breathing has stopped pure oxygen must be forced into the lungs

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under pressure. For major dental surgery normal anesthesia is required, but it is often necessary to invade the profound plane momentarily in order to attain normal anesthesia.

Our Technic.—Our technic differs from those already outlined. For *prolonged* anesthesia with nitrous oxid and oxygen we believe in a long period of induction. This obtains the necessary saturation with easeful accommodation of the tissues to the new conditions. In a way, we may compare this to the slow injection of novocain in conduction anesthesia. The bag is filled with nitrous oxid 92% and oxygen 8%. The patient is instructed to breathe normally, easily, through the nose and go to sleep. The mouth prop is inserted. The face mask is closely adapted. After four or five inhalations of atmospheric air the valve box on the inhaler is closed and the patient commences to breathe the gases from the bag. The valves are turned on, gradually decreasing the oxygen below 8%. During the slow induction stage the concentration suitable for the patient is determined. The face inhaler is removed. The nasal inhaler is applied. The pharyngeal pack is carefully inserted. Commence the operation if signs of good, normal anesthesia are present—regular, machine-like breathing, slightly more rapid than normal; color slightly dusky.

With an induction, during which the requirements of the patient have been established, an even anesthesia can generally be maintained with little variation of the concentration.

Nitrous Oxid an "Indifferent" Gas

Nitrous oxid, so far as is known, undergoes no chemical combination with any of the tissues of the body. Spectroscopic examination of the blood during anesthesia has revealed nothing definite in new hemoglobin combinations. The spectrum of hemoglobin saturated with nitrous oxid is the same as of hemoglobin alone. Purists in language may object to the terminology, but it is on this basis that we speak of nitrous oxid as an "indifferent" gas. (Peyton Rous of The Rockefeller Institute is studying colorometric changes in functioning organs under different gas anesthetics and we look forward to some illuminating results. Wieland, as others before him, speaks of a "Winterschlaf" during anesthesia-hibernation).

"Reduced Intra-Cellular Oxidation."—For years many of us have been in search of another "indifferent" gas but with which sufficient oxygen could be used to maintain the normal oxygen content of the blood. In nitrous oxid-oxygen anesthesia the oxygen content of the blood is markedly reduced.

"Because of the action of nitrous-oxid on the intra-cellular oxidation, its use is fraught with danger," (Crile).

"Anoxic-anoxemia is always present," (Greene).

Ethylene-Oxygen Anesthesia

At first the findings of Brown, Luckhardt, and Carter elated us. It was shown that much higher percentages of oxygen could be used with ethylene for anesthesia than with nitrous oxid. It was reported that 20% oxygen with 80% ethylene would produce anethesia. Our clinical and laboratory findings did not agree with these reports. As the enthusiastic users of ethylene appeared to agree among themselves, and as our figures disagreed with them, we secured an apparatus, different from the one we had been using, and similar to the one that was in common use in the hospitals from which the reports on clinical and laboratory findings with ethylene were being issued. We soon found the source of their error. It had been taken for granted that the flow of nitrous oxid and of ethylene was the same. The nitrous oxid gauges had not been corrected for ethylene. Until lately ours were the only gauges especially calibrated for ethylene and acetylene.

Ethylene-Oxygen Technic.—Our technic for ethylene and oxygen is the same as for nitrous oxid and oxygen, except that more oxygen is administered, on the average probably 7 to 12%. The induction period is, in general, shorter. The patient may appear one or two strata lighter and the same operative procedures may be performed as would require the deeper strata with nitrous oxid and oxygen. There is less need of a vapor synergist, although a small amount of vapor synergist is quite an advantage. Vomiting and retching, although brief, are more prevalent than with nitrous oxid and oxygen.

Cyanosis.—A few years ago in speaking of nitrous oxid and oxygen anesthesia, we said that cyanosis should never be permitted for any length of time. During maintenance it may appear momentarily but should never be continued. With animals we have never been able to get and maintain nitrous oxid and oxygen anesthesia without some cyanosis. Is it possible with the human? Evidently not, if we are to give the word the broader meaning of reduced blood aëration. The Greek root, however, means dark blue—thus we speak of certain cyanogen compounds which are deep blue. In this latter sense neither is the animal or the human kept cyanotic except momentarily. Let us say rather that they cannot be kept pink. As from 7 to 12% oxygen is permitted with ethylene, neither can the animal or human be kept pink with ethylene and oxygen. If we added a vapor synergist to the gasses increasing the oxygen content, pinkness may be obtained.

The Goal Unattained.—To repeat, when, in 1922 and 1923, Brown, Luckhardt and Carter presented their findings we were all overjoyed. An important step forward had been made. But further laboratory study and clinical experience soon showed that the

much desired goal had not as yet been reached, as much less than the percentage of oxygen in the air can be used with ethylene.

Acetylene-Oxygen Anesthesia

Acetylene-oxygen meets the demands more fully. Our research, founded upon the research and clinical experience of our German confreres, and our clinical experiences since December, 1924, in the use of nitrous oxid-acetylene-oxygen for extraction and oral surgery, prove that a long step forward has been made in the search for an *ideal* general anesthetic. With nitrous oxid-acetylene-oxygen the oxygen content of the blood is normal throughout the anesthesia.

When we began giving acetylene-oxygen no one had as yet used this anesthetic for the extraction of teeth or for oral surgery. Mr. Coltman, the chemist who had helped so much in purifying the gas, holds the distinction of being the first patient to take the gas for this purpose (the removal of two teeth and of an area of rarefaction about them). The anesthesia was maintained 5½ minutes, the oxygen being gradually increased from 25 to 45%, (October, 1924).

Lately one of us took the gas for the removal of infected adenoids, J. T. Gwathmey and the other of us giving the anesthetic. The anesthesia was maintained for 12 minutes during which the oxygen was gradually increased from 20 to 53%. In both instances the patients woke up smiling, with no retching or vomiting afterward. In Mr. Coltman's case a pharyngeal pack was used. In the other case there was an ingress of air by way of the mouth throughout the operation, but this did not interfere with the anesthesia. The patient remembers the first seven breaths through the nose-piece. From then until he was moved to a stretcher to be wheeled to the elevator he remembered nothing. Face and cheeks remained ruddy throughout the operation.

Herman Wieland in the January, 1925, issue of the *British Journal of Anesthesia* writes, "Up to the present this mode has been employed only in general surgical and gynecological operations. Experience as regards suitability for operations in ear, nose, and throat, as well as teeth is wanting." This want we have begun to fill. At the beginning of 1924 we commenced the use of acetylene. The anesthesia would be started with nitrous oxid and oxygen to disguise the odor, then we would either add ethylene to the other two gases or substitute ethylene for nitrous oxid. Except that most writers were unintentionally in error in regard to the percentages, our findings agreed with theirs. Ethylene is superior to nitrous oxid. At the end of 1924 we substituted acetylene for it. The contrast between acetylene and ethylene is greater than that between ethylene and nitrous oxid. *Ethylene and acetylene have exactly the same disadvantages. Acetylene has a most important added advantage.*

Nitrous Oxid-Acetylene-Oxygen Technic

The nasal inhaler is adapted and the mouth prop inserted. To disguise the odor we start with nitrous oxid and oxygen. After about 8 to 15 inhalations we shut off the nitrous oxid and administer acetylene 80% and oxygen 20%. The patient loses consciousness in one minute. The oxygen is increased 27%. The towel over the mouth is removed. The pharyngeal pack is carefully inserted and the mouth prop is sometimes re-adjusted. The roots to be removed and the area are carefully examined with the aid of a pair of college pliers or an elevator. If the operator has passed through the school of experience leading from (1) Nitrous oxid alone; to (2) Nitrous oxid with oxygen in short periods of induction; to (3) Nitrous oxid and oxygen with longer periods of induction; to (4) Nitrous oxid and oxygen with vapor synergists; to (5) Ethylene and oxygen alone and (b) with vapor synergists; if he has passed through this school of experience he has learned to do his work carefully and well and not in haste. Previously, in speaking of ethylene-oxygen, we said, "The patient may appear one or two strata lighter and the same operative procedures may be performed with as thorough a brain block as would require the deeper strata with nitrous oxid and oxygen." With acetylene and oxygen the patient appears to be one or two strata still lighter than with ethylene-oxygen and the same surgical procedures may be carried out with a total brain block. During the maintenance stage we raise the oxygen content gradually every two or three minutes to a concentration which appears to be best for the given case. Should the patient show signs of waking we decrease the oxygen to 27% for one minute, and then gradually increase the oxygen content again to a point below the oxygen content that was reached at the time the waking appeared to occur. As a rule the longer the anesthesia the higher the oxygen content. The patient awakes in one to three minutes.

Gas-Oxygen Apparatus

Nitrous oxid, ethylene, acetylene, carbon dioxid and oxygen are stored in tanks under high pressure. These gases are to be delivered to the patient in desired volume and concentration under ordinary or slightly increased atmospheric pressure. On the way to the inhaler they may be made to take up a vapor synergist.

There are many good machines for gas anesthesia on the market. All are simple. Their complexity is only apparent. The novice will master the mechanism in a shorter time than it would take him to learn to run a Ford.

The function of a gas apparatus is to deliver to the patient gases under low pressure from tanks containing the gases under high pressure; and to permit an easy change in the volumes and the proportions of the gases.

Lung Respiration.—The piping and the breathing bag are an extension of the patient's lungs. The gases pass into the lungs and mix with the reserve and residual air in the alveoli of the lungs. A luxurious capillary network studs each air cell. The thinnest of partitions separates the gases of the lungs from the blood supply—the single layer of flattened cells of the air cells and the single layer of thin endothelium of the capillary. The surface over which the gases are almost in contact with the blood of the capillaries, is over 100 times the surface of the patient's body. The venous blood of the pulmonary arteries absorbs the gases from the air cells. The blood stream passes to the heart by way of the pulmonary veins and is coursed through the body. The process is the same whether nitrogen and oxygen, or nitrous oxid, acetylene and oxygen are inspired.

Apparatus for More Than Two Gases.—The apparatus for acetylene and oxygen will not differ from that for nitrous oxid and oxygen, except that the gauges must be recalibrated. An apparatus for three or four gases will have three or four intake tubes instead of two.

What do we require of an apparatus?

(1) To give us, with ease, a regular flow of the gases in the volumes and the proportions we want them.

(2) With ease, and at a glance, both the operator and the anesthetist should be able to determine the proportions and the volumes of the gases delivered.

(3) In the course of the gases there should be a container for adding to the gases whatever vapor (anesthol, ether) we may desire.

Preparation of the Patient

No food for four hours or more before administration. The toilet necessities are attended to. Clothing is so arranged as not to interfere with the breathing. Appliances, such as hernia belts, should not be removed.

Posture.—Backrest 30 to 40 degrees to the horizontal. The position of the head should be such as not to produce undue strain of the muscles. The head should be *parallel* to but *not* in line with the back. We all stoop; the older the patient the greater the stoop and the more will the head be forward of the shoulders.

Physical Examination.—Questions as to health, references to heart disease, stethoscopic examination, generally speaking, do more harm than good. If the patient can walk into your office, nitrous oxid-acetylene-oxygen, properly administered, will not be contra-indicated.

Confidence and Good Cheer.—Our usual routine is to have the patient's friend, if the patient is not alone, in the operating room with him. It reassures him as does your good cheer, your smile, your confidence, and as does the smile of the patient who has just come out of the operating room.

We are believers in stage play or suggestion—whatever you may call it. The sterile instruments, in a sterile towel, have been laid out, if possible before the patient enters the room. You speak your few lines, the nurse speaks her few lines—words that you have probably repeated ten times already that day—words to calm, to comfort, to reassure, words giving ease, good cheer, and confidence to the patient. After a few inhalations, by a sign of your hand and eyes, you ask the patient's friend to return to the waiting room. At the beginning of the inhalation words of commendation and reassurance are in place. The tone is more important than the comment. It should be soothing. Your voice and words can be made reassuring, hypnotic. A proper choice of words suiting the occasion can surely be made of value. "Breathe easily, normally." "Think of something happy." "You are a very good patient." "You're the best patient."

Foresee the Effects.—The anesthetist must remember that the control of the gas taps does not at once control the gas supply in the blood. What you feed through the cylinders at one moment is not what the patient's tissues are receiving at that moment. It is not what the patient's lungs are receiving at that moment. Nor does it even determine at once the combination of gases in the breathing bag. The anesthetist judges what the effect of the concentration he is giving at one moment will be in a little while. He knows that the effect upon the patient at the moment he is turning the taps is a result of what the patient received some time back.

End of Anesthesia

At the completion of the operation, whether it be merely a single extraction or an extensive operation, the gases are cut down. By the attached string you remove the gauze packing in back of the mouth. You replace it with a similar packing, probably not so far back. You swab out the mouth with sterile gauze and place a gauze pack over the area operated. The oxygen is being continued for a while with carbon dioxid. You have given an anesthesia simulating natural sleep. From natural sleep one awakens quietly, slowly, serenely, peacefully, calmly. Let the patient return to full consciousness as serenely, as calmly. (As you note that he has come to sufficiently to understand, you may say in a cheerful,

soothing manner, "That's fine....You're a splendid patient.....very pleasant.....very pleasant.") The patient is regaining full consciousness. You ask him not to soil his clothing; to spit into the basin which is held at his chin. You ask him to push out the mouth prop with his tongue. If he is attempting to remove the prop but appears to have difficulty you say, "Shall I help you?" and gently disengage the prop.

Rinsing.—We have already emphasized our opinion that rinsing is not indicated. It is merely a tradition the patient has inherited. Generally he should be told not to rinse for about two hours after the operation.

Hemorrhage.—We believe more cases of hemorrhage after extraction are caused by the following two factors than by all other factors combined:—

(1) Disturbance immediately after extraction by superfluous rinsing while the patient is still at your office and for the day following.

(2) Disturbance of the wound one or two days later in removing the graying film over the wound, or in probing the area of extraction.

A Typical Experiment

The subject will probably be made more lucid if we report a meeting of the New York Society of Anesthetists, (March 26, 1925). Part of the evening was devoted to experiments upon animals with acetylene-oxygen. At 5:30 P.M. an albino rat was put into a glass container with an inlet and on outlet for the gases. A concentration of 30% oxygen and 70% acetylene was passed through the container for 3 minutes and the albino rat was then inserted and the stop-watch started. The animal was on his back in 2 minutes. We went out for dinner and returned in 40 minutes to find that the animal was deeply anesthetized with the breathing regular, machine-like; and the color good. The concentration of the gases had changed slightly to acetylene 70 minus and oxygen 30 plus.

At 7.49 P.M.—the animal under anesthesia over 2¼ hours—the acetylene tank was becoming empty. The concentration had changed to acetylene 72%, oxygen 28%. No valves had been touched since they were set at 5:30 P.M. We attached a fresh acetylene cylinder and reset the concentration at, acetylene 70% and oxygen 30%. At 8:25 P.M., while a group of us were comparing various anesthetics we noticed that the animal, oblivious to all that was going on about him, was in good color, respiration regular, while we, the anesthetists, were almost equally oblivious to him. At 8:30 we retired to another room. The meeting was called to order. No one was left in the room with the animal. The concentration had changed slightly—acetylene 68%, oxygen 32%. At 9:45 A. F. Erdmann and one of us stepped in to look at the animal and found that his respirations were regular and his color good. The concentration had remained almost unchanged. At 10:15 the meeting was adjourned and we all went in to look at the animal. The concentration was acetylene 72%, oxygen 28%. The respirations were regular, the color good.

We discussed the apparatus. The only new feature is two flowmeters to indicate the rise or fall of the pressure of the two gases by the rise or fall of two columns of colored water in two ordinary glass "U" tubes. The gases are tapped before they enter the sight-feed and are led to the flowmeters by rubber tubing. Here is the percentage chart:

Percentage Chart

Acetylene Readings

Oxygen Readings C.M	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0
4.5	28	20	15	12	10	8	7	6
5.0	40	30	24	20	16	14	12	10
5.5	50	39	32	27	23	20	17	15
6.0	61	50	42	37	31	28	24	22
6.5	70	61	53	47	41	37	33	30
7.0	76	67	60	55	48	44	40	36
7.5	79	71	65	59	53	49	45	41
8.0	82	75	69	64	58	53	49	45

We determine the volume rate of flow for every rise of ½ cm. from 4½ cm. to 8 cm. for each gas. This is checked by collecting many samples and analyzing them chemically, separately for oxygen and acetylene.

Precautions

Some doctor asked about the explosion hazard. We answered that in this type of machine we see little danger, if the thermo-cautery is not used. In Germany acetylene-oxygen has been administered over 25,000 times. Prof. Gauss alone has had it administered in his clinic for over 5,000 operations lasting from a few minutes to over 4 hours. Thus far there has been only one explosion, that reported by Prof. Hurler in the *Münchner Med., Wochenschrift,* October, 1924. The patient suffered some burns of the skin. No one else was hurt although much excitement was created in the clinic by the noise of the explosion. The blame rests directly upon the operator who took lightly the warning that a thermo-cautery should not come in the vicinity of the anesthetic. This operator had disregarded the warning frequently. This time as he was removing the cautery from the abdomen the explosion took place. A few weeks later, following a paper read by Prof. Gauss, Geheimrat Doederlein, the director of the Münchner Frauenklinik, stated that the advantages of the new anesthetic had no relationship to its one disadvantage—thermal cautery not to be used. The new anesthetic is again being given extensively at the clinic. This is the only explosion that has been reported with acetylene-oxygen. The sad experience in Baltimore of a year ago was mentioned. J. T. Gwathmey and T. D. Buchanan and a number of others are convinced that there was an oxygen ex-

plosion. A number of explosions with ethylene due to static sparks in cold dry weather were mentioned. Fortunately little harm was done in any of these accidents.

Humidification.—In a letter to us, Prof. C. D. Leake writes, "The danger of explosibility is present simply from static which may be generated by the flow of the gas past a metal opening." Our answer in part is, "If the gas is humified by passing through water before it reaches the metal opening, can a static spark be created?" In letters to I. C. Herb and to F. H. McMechan we stated that, "Dried rubber will encourage the creation of a static spark. However, if the rubber is kept moist a static spark will not be caused." We would rather turn this into a question at present.

A spark may be created, say by the operator's gown touching the metal nose-piece. This, however, can be made of a material, contact with which will not create a spark.

In a report on explosibility of ether lead through pipes, the A. I. du Pont de Nemours Company (1919) mentions the use of small metal arrestors in the piping. May not one be placed between the breathing bag and nose-piece?

"In the early history of Zeppelins, the static spark danger, we understand, was met by coating the Zeppelins. In flour mills, we are told, much damage used to be caused by sparks from belting touching off the very combustible particles in the air—and that danger has been overcome."

The incidence of ether explosions it would be well at this time to clear up. That they occur in this country a number of times a year is certain. They do not make good newspaper copy and so are not reported.

"Would it be a brilliant thing to put a flame to an ether soaked towel?" Such and similar, not very brilliant statements we have been guilty of—statements showing an ignorance of the danger from static and pyraforic sparks. As a matter of fact we used ethylene-oxygen for many months totally ignorant of any danger from sparks.

We have also stated that, "Acetylene is no more dangerous than ethylene, and that ether is more explosive than both." Here again the wish may have been father to the thought.

What is the truth? We do not know, though we have been seeking it from hazard experts, fire underwriters, engineers, and chemists.

A static spark can be produced by rubbing the feet along a carpet and touching a bit of metal. Enough of a spark may thus be created to light ordinary illuminating gas. If, however, you wear rubber gloves no spark can be carried from any part of the glove. In cold, dry weather static can be more easily created than when the humidity is high. Means can be furnished to sufficiently humidify an operating room to either reduce or to entirely eliminate the possibility of creating a static spark—conducted either from a person to a piece of metal or from one piece of metal to another.

As to sparks caused by two metals striking each other—

(1) Sufficient force is necessary.

(2) Metals vary. Two steel instruments striking each other with great force will produce a spark. We doubt whether two pieces of aluminum can be made to strike with sufficient violence to raise sparks.

If a spark could be caused by a forceps striking a tooth filling or striking a crown, the use of ethylene or acetylene should be stopped at once. But sparks cannot be produced in that way.

FIVE HOURS ANESTHESIA—AWAKE IN ONE MINUTE

In the discussion, our experimental albino rat, deeply asleep, breathing regularly, in good color, has been forgotten entirely. At 10:30 P.M., five hours since the commencement of the anesthesia, the stopwatch is set, thirty anesthetists looking on, and we remove the animal into the open air. In less than one minute he is on all fours walking about the table. In no way that we can recognize does he show any signs of having been under an anesthetic.

Interest among the spectators is now keen. Questions come thick and fast. The leading question is, *"What is your technic?"*

Our work is extraction and oral surgery. We apply the nose-piece with the usual care. A mouth prop is inserted. We commence by administering nitrous oxid 95% and oxygen 5% and a raise to 20% oxygen. In about one minute, we remove the covering over the mouth and insert a pharyngeal pack. We examine carefully the area of operation. Every 2 or 3 minutes we increase the oxygen until 50% acetylene is being given. We have seldom gone lower than 50% acetylene.

"Why do you start with nitrous oxid and oxygen?"—Because of the unpleasant, garlicky odor of the acetylene. In some of the German clinics the gas is passed over pine oil to give it a pleasanter odor.

"Is acetylene compressed into tanks like nitrous oxide or ethylene?"—No. If it were the chemistry textbook list of dangers would be correcet. But since 1897 it has not been put up that way. The tanks are filled with cement-asbestos fibers which divides its capacity into infinitely small spaces. The gas is dissolved in acetone. A bullet may be fired through the tank without danger. These tanks are daily bumped over bad roads in thousands of automobiles without danger.

Someone noticed a tank of carbon dioxid attached to the apparatus.

"Have You Used Carbon Dioxid?"—In some cases after the induction we add carbon dioxid to

the other gases and maintain it at 5 to 10% until the operation is over, when we discontinue the acetylene and nitrous oxid, and increase both the oxygen and the carbon dioxid. At other times we add carbon dioxid only at the end of the operation.

"What advantages has acetylene plus nitrous oxid plus ethylene with oxygen over acetylene alone with oxygen?"—We believe that the principles of synergism applies. Were we to return to nitrous oxid and oxygen we would as formerly add small amounts of a vapor synergist. The principle of synergism is seen clinically to apply. James T. Gwathmey five years ago before the American Association of Anesthetists said, "The theory, upon which this special form of anesthesia depends, is based upon the fact that each of the agents used affects the nervous mechanism in a different place and in a different way, with a resultant anesthesia that is more nearly perfect than if any one agent is used."

What Theory Is Acceptable?

There are a dozen or more theories to explain the loss of consciousness with ether, chloroform, nitrous oxid and other anesthetics. One of these theories is that recalled by I. W. Jones, in his article on "General Anesthesia" in the March, 1925, issue of the *Dental Items of Interest*. He says, "It is my belief that lowered oxidation is not only an accompaniment of anesthesia but that it is the essential feature of anesthesia."

Acetylene-oxygen anesthesia as presented by Wieland and Gauss in Germany and by ourselves in the United States raises many questions touching upon the *"Reduced oxidation theory."*

1. The air is a physical mixture of nitrogen 79% and oxygen 20%. The blood takes up this mixture. The nitrogen as it passes through the body undergoes no chemical change.

2. Nitrous oxid and oxygen are coursed through the body by the blood. The nitrous oxid undergoes no chemical change in the blood or in the tissues. With ethylene the blotches of extreme pinkness that are noticed frequently, although the oxygen content is far below normal, has led Luckhardt to believe that there is some loose combination of ethylene with hemoglobin. With acetylene we have noticed nothing similar. German laboratory workers have told us that acetylene is as *indifferent* as nitrous-oxid.*

*"The assumption made by several investigators that acetylene enters into chemical combination with the blood is now definitely refuted.

"Also Manchot's theory of a loose combination (chemical) with blood under certain temperatures is shown to be false. Herman, as early as 1874, stated that blood and acetylene enter only into physical combination. We find that correct.

"The oxygen absorption is in no way hindered by the presence of acetylene.

"Resumé:—The absorption of oxygen by the blood is no differently affected by the presence of acetylene than by the presence of nitrogen." (*Zeitschrift für Physiol. Chemie*, Vol. 127, p. 243, 1923; also p. 254).

"The capacity of the blood to take up oxygen is in no way changed by the presence of acetylene.

"Resumé:—The presence of acetylene effects in no way the oxygen content of the blood." (*Zeitscrift für Physiol. Chemie*, Vol. 131, p. 131)

3. Nitrogen has a low power of saturation with water or blood—4 volumes per cent.

4. The saturability of nitrous oxid in water or blood is much higher than that of nitrogen—about 50 volumes per cent. Ethylene and acetylene have a still higher saturability. Acetylene saturability at body temperature in blood is 74 volumes of acetylene for 100 volumes of blood.

5. In the stages of development nerve tissue is the last developed. To function in the animal or human body that tissue requires much more oxygen than the other tissues—twice as much. When the oxygen supply is below normal the higher mental centers are the first to be affected and the vital tissues the last.

(a) In the average nitrous oxid and oxygen anesthesia the oxygen supply is reduced to 6 to 8%; less than half the normal. The margin of safety is about 2%; the vital processes cannot continue in the average human on less than 6% oxygen.

(b) With ethylene the oxygen supply varies from 7 to 12%.

6. Limiting ourselves to nitrous oxid and oxygen, and to ethylene and oxygen anesthesia, we have an apparently workable theory. Anesthesia is produced through the reduction of the oxygen supply sufficiently to affect consciousness, pain apperception and pain perception. The oxygen must be in sufficient quantity for the respiratory and cardiac functions to continue.

7. With acetylene instead of nitrous oxid what happens to our theory?—a theory we might extend to explain local anesthesia as the reduction of oxygen supply to the nerve endings. With acetylene the oxygen supply of the inspired gases is never less than 30% and usually above 40%.

8. When we speak of 7% oxygen with 93% nitrous oxid the reader has probably taken it for granted that this oxygen content in the inspired gases means the same to the blood and to the other tissues as 7% oxygen with 93% nitrogen. But must not the saturability be considered? The fact is that nitrous oxid is about 10 times as soluble in the blood as is nitrogen. Thus we may expect less reduction of the oxidative processes when 7% oxygen and 93% nitrogen are inspired than when 7% oxygen and 93% nitrous oxid are respired. The more soluble a gas the more reduction of the oxidative processes with an equal percentage of oxygen. Ethylene is more soluble in blood than is nitrous

oxid. We may, therefore, expect less reduction of the oxidative processes when 7% oxygen is inspired with 93% nitrous oxid than when 7% oxygen is inspired with 93% ethylene. Acetylene is still more soluble than is ethylene.

In a former article we said that if acetylene, ethylene, and nitrous oxid were equally indifferent, the organism would tolerate each with an equally low percentage of oxygen. What we have just said shows how incorrect we then were. Prof. Herman Weiland in a personal communication (March, 1925) says, "The action of a gas is logically determined not by its inspired concentration but by its concentration in the blood, or rather in the tissues. As the solubility of acetylene is greater than that of nitrous oxid, an equal concentration in the blood is attained with a lesser concentration of acetylene in the inspired gases. According to my belief anesthesia is secured when a certain, still unknown, concentration is secured in the nerve cell—which when expressed in volumes per cent—is the same for all these gases. I have no figures at hand for the solubility of gases in blood at body temperatures. These figures would also not be decisive in such a calculation as the rate of diffusion of acetylene and nitrous oxid in the tissues is not known. When one considers that the presence of a certain number of gas molecules in a cell will interfere with oxidation—even with a high percentage of oxygen—then one will understand the apparently more powerful action of the more soluble acetylene."

63 W. 48TH. ST.

Reducing the Surgical Risk in Gastro-Intestinal Conditions. T. G. ORR *and* R. L. HADEN, Kansas City, Mo. *Journal A. M. A.*, September 12, 1925.

Experimental results lead Orr and Haden to the conclusion that sodium chlorid has some protective value against the toxemia developed in high intestinal tract obstruction. Distilled water does not prolong life or return the blood chemistry to normal as does sodium chlorid. The sodium chlorid seems to be the essential factor in the treatment of the toxemia, and its estimation in the blood serves as an indicator of the degree of toxemia. It appears from experiments that there is always, to some extent, a depletion of the chlorids before protein destruction begins with a rise in the nonprotein elements of the blood. Just what the danger point is in the fall of the chlorids has not been definitely determined. It probably varies in different individuals. Orr and Haden feel that a blood chlorid of 400 in intestinal obstruction should be a signal for the generous administration of sodium chlorid. Judging from their experimental studies and observations of patients, it is essential to administer sodium chlorid in acute intestinal obstructon before operaton as well as after. The quantity of the salt necessary to return the blood chemical changes to normal can be determined by their precipitation in the urine with silver nitrate solution and comparing with the normal. Orr and Haden have made a rough estimate that 1 gm. of sodium chlorid per kilogram of body weight should be given as an initial dose in every toxic patient. This is best given subcutaneously in 1 or 2 per cent solution or intravenously in 5 per cent solution. Surgical risks may be lessened by the preoperative use of plenty of salt, and lives saved by its careful administration until the toxemia of intestinal obstruction has disappeared.

SHALL I FEAR AN ANESTHETIC?

FLOYD T. ROMBERGER, M.D.,
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Have you a surgical ailment? Are you a hundred percenter? Are you only a fifty percenter who can be raised to seventy-five or a hundred by means of surgery? Select your surgeon and choose your anesthetist, then place your confidence in them; and, they will see you safely through if it is within the bounds of human possibility.

Misinformation, direct and indirect, has caused many untimely deaths. A wrongly interpreted compass may throw the ship on the rocks—this is a direct effect. Lack of information, such as is now available, crashed the Titantic into the iceberg—thus, indirectly, causing a great loss of life.

PUTTING IT OFF

In the minds of the laity there exists a mass of erroneous beliefs—and rumors—concerning surgical anesthesia; that sleep of unconsciousness needed by the surgeon to skillfully perform his work. And it is from a recorded experience of over five thousand personally administered anesthetics, *plus* the equally important observation of many thousand others, that I wish to tell you the true story—frankly.

Are you afraid of the anesthetic? If so, why? Ask yourself these questions and then give honest answer. If the answer is "yes," ninety-nine times out of a hundred it will be because of some repeated and perhaps grabled account of, *"my sister's husband had a brother, whose mother-in-law had a cousin, whose son's wife was operated on and she never woke up."*

To die is easy—Oh! how easy! In fact it usually happens without any effort on the part of the deceased. It is simple, you merely go to sleep and then sleep on—and on—and—on. But, to live, especially in this day of rush and hustle, to live one hundred percent, that indeed is hard; it is hard to find food and clothes for the wife and babies, still harder to pay the life insurance premiums and buy gas for the flivver.

Yet, your life is the most important thing in this world to you; when you are sick, crippled, or gone, the world will pass you by. However, few of us are one hundred percenters physicially, or even, perhaps, not quite ninety percenters; a little lag here, a little drag there, reduces our efficiency. Perhaps it is only the teeth or tonsils; perhaps it is a smouldering appendix; or, it may even be only a vague indefinite feeling of something wrong. But

*Read during the Joint Meeting of the Eastern and Mid-Western Anesthetists with the American Association for Regional Anesthesia and Academy of Stomatology, Hotel Adelphia, Philadelphia, October 26-30, 1925.

you delay going to see your doctor because he may suggest surgery, and, you say—yes you do—"I'm afraid to be put to sleep." So you put it off—until it may be too late.

"How do you know?" you ask. In many, many ways. Hundreds of times patients say to their surgeons, "Doctor, I am not afraid of the operation but I hate to take the anesthetic." Again, hundreds of times, when the surgery is performed conditions are disclosed which, had they been taken earlier, could easily have been permanently cured; but, because you were afraid—just put it off—and off—because you feared to chance the anesthetic—anything more than temporary relief is impossible.

WHAT ARE THE CHANCES?

Now, what are the chances? With the more common anesthetic agents, statistical facts are available. With chloroform we find the death rate estimated as being one in 3,000 by one authority, while another collection of records discloses it as one in 2,665. Chloroform was developed in England to match the anesthetic use of ether in the United States and is more frequently used there than in this country. Though it is a worthy drug, properly used, in its place, it has largely fallen into disuse in our hospitals.

Concerning ether, widely used here, Dr. W. W. Keen, of Philadelphia, has compiled records of 262,002 administrations with a death rate of one in 7,705; a still larger collection of 864,163 records shows a rate of one in 8,010.

With nitrous oxid oxygen anesthesia, the so-called "laughing gas," the late Sir Frederick Hewitt, of London, could find only thirty deaths in a search of the records in the literature of a period of forty years. Dr. Chas. K. Teeter, a dentist, of Cleveland, collected reports totaling 1,161,820 administrations with but two deaths. Dr. W. D. Buxton, of London, reports a compilation of 1,001,000 cases with but one death. Dr. J. T. Gwathmey, of New York City, most conservatively estimates the rate in major surgery as being one in 20,000.

These are not selected cases or reports, they are the records of all classes of surgical risks just as they presented themselves for surgery; the hundred percenters, the fifty percenters, and the five percenters. That even this rate is not due to the breathing or inhalation of the anesthetic vapors alone, but rather to the condition of the patient, can be shown by a study of the death rate for surgery performed under local or regional anesthesia. Drs. Violet and Fisher report 30,000 cases of spinal anesthesia with a death rate of one in 633. Dr. Strauss reported records of 22,717 cases with a rate of one in 494; and under scopolamin injections, 39,208 cases showed a rate of one in 666. It must be explained, however, that in all probability these were only the mo desperate risks, the five, two, or even only one p centers—where an inhalation anesthetic was contraindicated.

From these figures you may see that the risk fro the anesthetic itself is not great. Every time yo cross the present-day busy street you are taking greater chances. Every time you take a swim in the lake you are assuming a certain, definite, figurable hazard. There is really no risk from the anesthetic in a normal individual; the only conceivable cause of fatality would be overdosage or improper administration.

IN THE HOLLOW OF HIS HANDS

But we are not all one hundred percenters, or normal. All the more reason why you should exercise great care in the election of the one who is to administer the anesthetic. You should be just as selective of your anesthetist as of your surgeon. He it is who will go with you down into the valley and shadow to be your friend and guide. His experience and his judgment must be your safeguard. Every minute—yes, every second—he is watching your pulse, your respiration, your color, your blood pressure, and many additional factors. It is believed that a physician with special skill and training can do this best for you; his judgment is more ripe; his understanding of your physiology and pathology, his estimate of what must be done to cure, and what can be safely done—your safety—is more mature. If an orderly or nurse gives the anesthetic then the surgeon must direct and he assumes double duty; surely, you want him to give his undivided attention to his knife and scissors. Most surgeons are willing to do this, it is a factor further safeguarding your interest.

You can well marvel at the organization of the modern operating team—the special skill in administering the anesthetic, the highly trained surgical nurses, the surgeon and assistants accustomed to working together, each team-mate anticipating the other's next move. All this is done for your safety. Observe also the special instruments designed to facilitate the work and save time—detachable knife blades of razor edge, used but once and then thrown away because they cannot be satisfactorily resharpened; needle holders and scissors gold plated or japanned black, so that they stand-out, are easily recognized, no time is lost pawning around to find them; instruments with a curved ledge on the handles, so that they do not lie flat, can be readily grasped; scissors with springs, so that no energy is required to open them; gauze sponges with tapes sewed on and these tied to heavy rings, so they may not be left, preadventure, in the abdomen. All these are safeguards for you.

Steam pressure sterilization of sutures, needles, instruments, gloves, caps, gowns, masks, and dressings is employed to prevent infection. This is why the present-day operative wounds heal so quickly; why; after an appendix or goiter operation, you can often walk out of the hospital to your taxi in from five to seven days.

Anesthetic—A Mental Hazard

Knowing all this, yet you say—yes you do—"Doctor, I am not afraid of the operation but I hate to take the anesthetic." It is natural for us to fear the unknown, but anesthesia is only a *mental hazard*. Anesthetic sleep is just like natural sleep, only deeper; you feel no pain, your reflexes are abolished. If you can compose your mind, go to sleep just as though you were taking a little nap on your couch at home, the experience will be a pleasant one rather than disagreeable.

A close friend once said to me, following an anesthetic, "Doctor, I went off to sleep as easily, as if you had held to my face a bouquet of sweet-smelling flowers." It was a beautiful tribute and made me feel as though there is really some appreciation in this world.

Children who have been raised by the boogy-booman method are very difficult to anesthetize. They cry about everything and are afraid of everything; they must be restrained. One can very often tell what the home training has been by the way the child takes the anesthetic. Usually, however, they are easily interested in their surroundings and it is pleasant to work with them. Their attention is attracted by talk about their name, their age, or about their school. The Sandman tells them stories, and how intently they sometimes listen, as they drowsily drop off to sleep. Peter Rabbit, Towser the Hound, Johnny Skunk, and Jimmy Crow, all are interesting characters, very much alive to them. Many times after their recovery they will ask the nurse to have the story finished. Thus quietly to induce anesthetic sleep is an art, the aim of every anesthetist. If it has been done pleasantly, children always remember it as such and never have a fear of it again should occasion require. On the other hand, if they are terrorized they never forget it, and are likely to carry that fear on into adult life. The next anesthetist who meets them has indeed a task on his hands.

Somewhat older children often ask, "Aren't you going to give me something to smell so that it won't hurt?" Here the parents have laid the foundation for an easy anesthetic sleep for their child. One little girl of 4 years to whom I was telling a story about a big, big monkey—she was drowsing off, half asleep—said, "Well cut out this monkey business, and—" but before she could finish she had dropped into the land of forgetfulness.

Adults are but children grown up, and a varying array of conditions must be met. Some have had hospital experience, others not; some have every confidence, others must have it instilled. The hardest adults to anesthetize are those who are afraid, and some really approach this phase of their surgery with terror in their hearts. A sense of responsibility hits the anesthetist like a blow in the face when his patient says, "Doctor, I'm afraid; are you sure I'll wake up?" It also takes a great deal of assurance and calmness on his part not to become panicky when the patient says, "I know this will kill me; I'll never awaken again." Who is so omnipotent as to be able to answer? One needs special care in these cases; their abnegation starts both anesthetist and surgeon with an additional handicap.

Many patients will say, "Be sure I'm deep enough," or "Don't let them begin until I'm sound asleep." While this is superfluous advice, it indicates a composed state of mind and they usually sleep easily.

Persons who have suffered long and are praying for relief welcome the anesthetic as a means of getting well. They are easily anesthetized.

The patient in whom it is possible to induce sleep easily requires less anesthetic to carry him all the way through his operation. He recovers more quickly from its effect, suffers the least, and has the best chance of getting well. Hence no measures are overlooked which might possibly aid in this case of inducing anesthetic sleep. You are usually given a small opiate, hypodermically, before going to the operating room. This itself makes you somewhat drowsy and helps your peace of mind for your sensibilities are less acute. The anesthetist will chat a word with you, arrange for your comfortable position, raise or lower your head that you may breathe easily, scratch your nose it it itches, and give you other small attentions. Meanwhile he has taken your pulse, read the findings on your chart and history, listened to your heart, taken your blood pressure if it is unrecorded; and, most important, he has given you a close, general appraisal. He balances in his mind the elements of risk and weighs them with what he knows you must pass through while under his care.

The Fascination of Anesthesia

On all well regulated operating teams the word of the anesthetist as to your condition, before and during the surgery, is final. Many times he finds the surgeon pushing you to the very brink, in the effort to get you well, and it is the anesthetist's duty, ever watchful of your interest, to issue the warnings in time.

When you are made comfortable on the table all

you need to do is to breathe quietly and easily as in natural sleep. With modern methods, in from 45 to 90 seconds you-are——off———to———sleep.

It is really an interesting experience and can become fascinating. I admit it has a peculiar appeal to me. I have been anesthetized by others and have put myself to sleep many times, just to see how it could be done most easily, to catalogue the effects, to help my work with others.

An amusing incident occurred one time when I was trying to see just exactly how many breaths of nitrous oxid (laughing gas) I could take before becoming unconscious. I wanted to take enough to lose consciousness just one second after turning off the valve—to see whether I could turn off the gas at the exact moment I felt myself slip off. I was sitting at the head of the operating table waiting for a patient to be brought up stairs, mask over my face, hand on the gas valve. After five or six breaths—this happened quicker than it takes time to tell—I thought to myself, "Now I will take one more breath and then shut off the valve and take a little snooze." But I forgot to turn off the valve, I had lost consciousness and the power to move my hand, and I woke up a minute later on the floor.

The nurses told me afterward that I fell off my stool, struck my head on the radiator, then hit the floor with a smile on my face. Of course the mask dropped from my hand, I began to breathe air (oxygen), and in a minute I was awake none the worse for the experience, except the bump on the head, which I did not feel.

The effect of this agent is so fleeting that I suffered no ill effect at all; in fact, five minutes later the patient was brought in and I administered the anesthetic for a major operation. But I was a little wiser.

Talking in Your Sleep

Some persons dread the anesthetic because they fear they will talk in their sleep. This is largely a myth. Under modern methods of inducing anesthetic sleep, consciousness is lost so rapidly that they don't have time to say anything. When recovering from the anesthetic they usually are so drowsy that they do not care to talk. In all my experience I have never heard any of the highly colored tales which some people take delight in relating about what they said when under the anesthetic. My appreciation of vaudeville is not dimmed, yet I have to pay fifty cents to hear it just the same as other people.

Some patients say, "Don't strap me down," under the erroneous belief that they will be held or restrained. This is never done except as a guard for your own safety. Fortunately, since the prominence of Mr. Volstead, we rarely encounter the old-time booze-fighter. Your arms are placed in short linen sleeves at the side of the table, not so much to restrain you as to keep them off your chest so that you may breathe more easily, and, so that they do not hang over the edge of the table when you relax in sleep—this could cause a pressure paralysis. After you first lose consciousness a stout web is passed over your knees—for your own safety. In your own bed at home, you often turn over in your sleep, and, the same could happen on the operating table during the early part of your anesthesia; it is only exaggerated natural sleep, but if you roll here you would fall on the floor. So your safety is guarded.

Every minute—every second—of your anesthetic sleep is guarded. During the operation you are watched by the anesthetist; following it, until you have fully recovered consciousness, by an efficient and specially trained nurse.

The Narrow Margin of Used Up Reserve

"Why, then," you ask, "do patients sometimes die during or after their operations?" They die because of disease, mode of living, neglect, and delay. Perhaps it is due to no preventable factor, either in mode of life, or in the care of the physician. For example, provident, prodigal nature has placed in your body seven times as much secreting kidney substances as is needed to sustain life. But, not many of us reach middle life or advanced years without having some of this placed out of commission. Every acute cold, every attack of tonsillitis, scarlet fever, rheumatism, or of many other common diseases, takes toll. Perhaps abscessed teeth or infected tonsils have helped. Also, overeating or overdrinking may have aided in kidney destruction. Nevertheless, this we know, many persons come to the hospitals for surgery only after their kidney efficiency is very low. These are not good risks.

In the heart, too, nature has given you a big reserve, but, you may have used up part of it. Perhaps the blood pressure is high, indicating that you have been firing the boiler too hard—running under too great a head of steam.

Simularly, every vital function of the body must be evaluated before surgical treatment. Many times the surgeon and anesthetist are forced to work on an extremely narrow margin. While under surgery, you are being tested like an athlete in a race, and condition will tell the story.

Postoperatively many uncontrollable factors are encountered. Persons apparently in good health are known to have died at home in bed from heart failure or apoplexy. But let this happen in the hospital, and, if an operation had been performed it surely will be blamed. Again, persons feeling completely

well often contract influenza and pneumonia, yet, in the latter case, if an anesthetic had been recently administered, it is likely to receive the blame.

Patients under an anesthetic prespire profusely, but they are very closely guarded against drafts by being wrapped in hot woolen blankets while being moved from the operating room to their beds. In anesthetic sleep the skin and muscles are relaxed, the pores are open, and as the operation proceeds the vaso-motor tension is lowered, hence the patient perspires.

Your surgeon and anesthetist know all these facts and they weigh them carefully, along with many other factors—so that additional safeguards may be thrown about you. Veritably, your life depends on their judgment, so there is reason for their careful selection; and, once they are chosen, give them your every confidence.

Can you picture to yourself what surgery was like a century ago? The art of anesthesia has been developed in the last eighty years. All the anesthetic agents have been discovered since that time, and, notable advances in their administration have been made in the past decade.

Who can say how much of the progress which has been made in surgery, even up to the present day, has been due to highly developed anesthesia, They are very intimately associated.

In former days many people died from disease conditions which we now call quite simple, and which can be simply and permanently cured, owing to advances in the art of anesthesia.

Now, do you still fear the anesthetic? Don't! It is your friend in need. It eases the pathway to a cure. Simply follow the psalmist, as he says, "I will both lay me down in peace, and sleep."

501 Lafayette Life Bldg.

On the Administration of Water as a Renal Function Test. A. Norgaard. *Acta Medica Scandanavia*, Sup. 7, 304-9, 1924.

175 subjects were examined, about half of whom had renal disease.

The test mainly used in these investigations consisted in drinking a litre of water and examining the urine at hour intervals after. The water was passed at 5 p. m., and three specimens were discarded. It was voided again at 6:30 p. m. and this was taken as an example of the patient's power of concentration. A litre of water was then drunk before 7 p. m., and the urine was examined each hour from 7 p. m. to 11 p. m. The four-hour diuresis from 7 p. m. to 11 p. m. and the greatest difference in specific gravity (generally between the 6:30 p. m. and 7 p. m. specimens) were the points to which most attention was paid.

The Strauss test on the same principles but with a much larger number of urinary examinations was used in a certain number of patients. The author concludes that this test has the advantage of great simplicity, and that if both these factors are considered, useful information can be obtained, but that it is a test rather of the organism as a whole than of the kidney.

NITROUS OXID AND LOCAL ANESTHESIA IN ABDOMINAL SURGERY

P. K. Gilman, M.D.
San Francisco, Calif.

The fact that I have been honored by an invitation to address this meeting of anesthetists on the subject of combined anesthesia leads me to believe that some measure of success has crowned our efforts directed toward working out a method of surgical narcosis that is an improvement over mere etherization. Without the hearty co-operation of our staff of anesthetists at Stanford University Hospital the work, upon which this communication is based, would have been impossible. How many surgeons, I wonder, fully appreciate the important position occupied by the anesthetist in the surgical team? Do all anesthetists realize to the full this responsibility?

The Secret of Satisfactory Anesthesia

The patient's mental attitude should be studied by the anesthetist to ensure the best results. At times, unfortunately, the anesthetist looks upon the administration of an anesthetic merely as an incident in the day's—or night's—work, while to the patient it is one of the most important events of his life. How often it is a truth that the patient dreads the anesthesia, entailing complete surrender of personality, more than the actual operation. The sympathy existing between surgeon and patient should be as closely approximated as possible between anesthetist and patient.

The secret of satisfactory anesthesia lies in a close association of anesthetist and surgeon as well as a thorough appreciation on the part of both of the difficulties met by each. The anesthetist and surgeon should discuss the approaching patient and operation; should discuss the finished operation, the difficulties met and overcome by each separately and together. It is only by doing this that recurring difficulties may be overcome and further improvement secured. The surgeon gains by doing this, the anesthetist gains, and, what is most important, the patient gains inestimably.

Few, if any of you, have failed to witness at one time or another the difficulties of an abdominal operation when, from the opening of the peritoneum the intestinal coils well forth from the abdominal cavity in spite—or is it partly because—of the struggles of the surgeon and his assistants. The struggles persist and in attempting to close the wound every stitch tears out of the protesting peritoneum. The surgeon is tempted to blame the anesthetist. He may be to blame in part. The surgeon too often is

*Read during the Fourth Annual Meeting of the Pacific Coast Association of Anesthetists with the Section on Anesthesiology of the California State Medical Association, Yosemite Valley, May 18-20, 1925.

to blame. He is too often impatient to begin and his manipulations are too severe, his physiology and pathology are temporarily forgotten, and rough manipulations cause an immediate protective response upon the part of the patient. This response upon the patient's part still further impedes the surgeon, embarrasses the anesthetist and adds immeasurably to the postoperative shock.

This holds true not only when applied to operations under nitrous oxid-oxygen anesthesia but under any other form of anesthesia. Teamwork, co-operation, and the exercise of judgment are prime essentials, the use of which will smooth the way of practically all difficulties.

On too many occasions the anesthetist is forced to flood the patient with an excess of the anesthetic in order to meet the requirements of the unthinking surgeon. Rather should the surgeon pride himself upon the minimal amount of anesthetic employed consistent with progress and comfort on his part.

In order then to employ the method of *combined* anesthesia to be outlined a number of conditions must necessarily exist. There must be a sympathetic understanding between anesthetist and patient, anesthetist and surgeon and surgeon and patient. The anesthetist and surgeon must be in sympathy to best meet and overcome difficulties as they arise. There must be teamwork, teamwork of the finest kind, the kind that has been made possible at Stanford Hospital by the great interest and hearty co-operation of Dr. Caroline Palmer and her staff of physician anesthetists. No demand has been too exacting for them, no situation calling for patience has not been met.

A second point of importance in performing abdominal surgery is gentleness of touch, the feather touch if you please, on the part of the operator and his assistants. No one is in a more favorable position to appreciate delicately performed surgery than the anesthetist. Manipulations carried out under light anesthesia call for delicacy in order to permit the light anesthesia. The anesthetist who can secure proper working conditions with a relaxed abdominal wall under nitrous oxid-oxygen and local anesthesia must work with an operator who is capable of handling the contents of that abdomen without causing a continuous flow of impulses directed centrally.

Advantages and Difficulties of Combined Anesthesia

It has been said *"visions of perfect performances readily arise in the minds of those in whom steady mental concentration upon ideals induces a kind of self-hypnosis."* However that may be, during the past two years, during which period we have eliminated the use of ether in favor of at first nitrous oxid-oxygen alone, and later nitrous oxid-oxygen combined with novocain, we feel a distinct advance has been made and our patients immeasurably benefitted.

While we have eliminated the use of ether in all cases, excepting only the few whose financial condition precludes the added expense of nitrous oxid-oxygen, this communication will include only cases of *abdominal surgery*, practically all of them stomach and gall-bladder surgery, as this type of case presents at times many difficulties and tests the method of employing nitrous oxid-oxygen and local anesthesia as severely as will any other type of case. Since employing this method we have used it in 125 cases.

With this method a few minutes more time is often required to complete the operation than with the patient under deep ether anesthesia. This lone factor of doubtful importance is however vastly more than compensated for by many advantages. Among these may be cited (a) the greatly lessened shock due to a combination of the more benign anesthetics and necessary gentle operative manipulations; (b) the elimination in the majority of cases of all but possibly an immediate small emesis; (c) the absence of postoperative respiratory and renal complications.

Farr states that respiratory complications are feared, and justly so, after the so-called upper abdominal operation. Some hold the causes to be mechanical and in no degree due to the type of anesthesia employed.

Our experience with nitrous oxid-oxygen and local anesthesia causes us to disagree positively with this last belief. In our series of 125 cases no postoperative pulmonary complication occurred. One case only evidenced a mild bronchitis demonstrable during twenty-four hours—a case of cholecystectomy difficult by virtue of extensive gastric and duodenal adhesions, the patient suffering as well from intractable maxillary sinus infection.

Gregoire, writing last year (1924) on the pulmonary complications in gastric surgery reports these complications occurring in 11 per cent. of the cases operated upon for ulcer and in 12 per cent. of those operated upon for cancer under general anesthesia. In another series operated upon under local anesthesia only there were no postoperative pulmonary complications.

Much has been written upon local anesthesia and undoubtedly it has its place, and an important place. With local anesthesia *alone*, especially in abdominal cases, the strain on both patient and surgeon is greater. Further, occasionally unexpected difficulties are encountered necessitating a general anesthetic. To pass from local to general anesthesia in the middle of an operation is to be avoided. It is far better to begin by employing both, nitrous oxid

rather than ether, as the former affects the vital functions to a less degree than does the latter.

In our earlier cases nitrous oxid-oxygen *alone* was used and in a certain percentage difficulty was experienced in securing, (1) sufficient relaxation; and (2) closure of the peritoneum was occasionally almost impossible. Following the operation pain in the operative wound during the first days caused a number of patients, upon whom an upper abdominal incision had been made, to abandon the abdominal type of respiration thus multiplying conditions favorable to the development of pulmonary complications. To obviate these difficulties the generous use of a 0.5 per cent. solution of novocain was added to the method of anesthesia.

Method of Use

The patient receives no cathartic in preparation for operation, a cleansing enema being depended upon to evacuate the large bowel. As liberal a diet is allowed as is consistent with the patient's condition the day preceding the operation and the intake of water is encouraged up to an hour before the patient is transferred to the surgery. A preliminary opiate of morphin combined with atropin is administered one-half hour before the anesthesia is begun.

With the patient under nitrous oxid-oxygen the final skin preparation is done and when completed the entire abdominal wall on the side of the proposed incision, or both in the case of a midline opening, is blocked from the level of the sixth intercostal above to the anterior superior spine of the ilium below, this being done previous to the final draping of the patient.

The second use of the local anesthetic is just before the peritoneum is incised, when the entire length of peritoneum to be incised is infiltrated with the novocain solution. The greatest importance of this step lies later when closure is done.

From this point onward, at every step of the operation, teamwork and gentleness are the important factors leading to success.

Already, before the first incision has been made, the anesthetist has been consulted and has stated that the patient is ready. At the first sign of reaction, at no matter what stage of the work, all manipulations cease to allow the anesthetist to bring the patient again under complete control. This situation may arise not once but oftener during the course of unfavorable cases, but we have yet to experience the case in which this method of combined anesthesia has failed, if the operative manipulations be halted until the anesthetist give the signal to proceed. This is only a fair and just exchange for the effort on the part of the anesthetist in endeavoring to carry the patient at the point of minimum anesthesia compatible with the demands for relaxation.

On the part of the surgeon and his assistants no abrupt manipulations are permissible. Gentle opening and elevation of the incised abdominal walls permit the placing of a self-retaining retractor, the use of which eliminates the unfavorable stimuli of hand-controlled retractors with the ever varying intensity of pull of the assistant's arm.

During the operation no pressure is exerted but tissues are lifted and cut; traction on tissues and organs is gentle; sponging and clamping is done gently and the patient is treated as nearly as possible as would be demanded by the patient under local anesthesia alone with unimpaired consciousness.

Walling off within the abdomen must be done with slow firmness after briefly surveying the field to be exposed and planning carefully to avoid repeated manouvers accompanied by added unfavorable stimuli. Deep retraction to attain exposure must be steady and secured gently. When once secured it must be maintained as each added change in position of foreign material within the peritoneal cavity makes for stimuli that tend to arouse the patient.

Conforming carefully to these necessities it is surprising to see what a complete relaxation of the abdominal wall may be secured, with a patient under the lightest amount of anesthesia. It is not exaggeration to state an equal degree of relaxation may be secured to that produced by profound ether anesthesia.

On completing the operation a similar gentleness must be exercised in retreating from and closing the abdomen. All instruments and gauze must be eased out and never suddenly. When suturing the peritoneum a firm gentleness is again needed. This will be rewarded by an ease of closure not surpassed if equalled by ether anesthesia.

Conclusion

The advantages of combined anesthesia are striking. Since our manipulations are preforce gentle shock is largely eliminated. It is not rare for the patient to leave the table with an unchanged blood pressure. The patient is conscious by the time the postoperative toilet complete. The often distressing and prolonged recoveries of consciousness from ether are eliminated.

As already stated postoperative nausea and vomiting are practically absent, except at times for an immediate small emesis. Bowel paresis and accompanying distension and gas pains are markedly reduced in their frequency of occurrence. Combined anesthesia patients take fluids earlier, may be nourished sooner than the ordinary ether patient, convalescence more rapidly and suffer less general postoperative distress.—350 Post St.

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F. HOEFFER McMECHAN, A.M., M.D., *Editor*
Avon Lake, Ohio, U.S.A.

JANUARY EDITORIALS 1926

HOW CAN WE ELIMINATE STATIC FROM OPERATING ROOMS TO AVOID ACCIDENTS WITH ANESTHETICS?

Dr. E. I. McKesson, of Toledo, Ohio, discussed this problem before a Round Table Conference of the American Hospital Association, during its recent meeting at Louisville, October 19, 1925, and on account of its importance to all concerned his remarks on that occasion are being printed in full:—

"Most hospitals have had the unpleasant experience of a fire or explosion in their operating rooms with ether anesthetic. Rarely is any one seriously injured, although deaths have resulted among the patients in a few instances from the resulting fracture of the base of the skull, ruptured trachea or hemorrhage. Burns constitute the usual injury. The possibilities are, therefore, serious and sufficiently unusual to favor damage suits.

Ether or ethylene, when mixed with air or oxygen, burns at some mixtures, and explodes at other mixtures. The range of mixtures is unimportant, since combustible and explosive proportions may be and are produced at some stage in every ether or ethylene anesthetic, which is administered. Fortunately, it is practically impossible to so charge the air in the entire operating room with enough ether or ethylene to produce an explosive or combustible mixture, as ordinarily used. However, currents of these vapors may float several feet into a flame ignite and flash back to the source of the vapor,—*namely*, the inhaler, or an ethylene tank may fall over, loosen the valve and rapidly releases a dangerous quantity of this gas into a room. There is no danger, of course, if there is no fire to ignite it.

No one would claim that ether or ethylene should be used in the presence of known sources of ignition such as the cautery, diathermy, *x*-ray apparatus, flames, etc., when we have nitrous oxid and oxygen, which is non-combustible and safe for those cases requiring the use of such equipment.

But elimination of known sources of ignition in the operating room does not prevent that tiny static spark from producing precisely the same results. Static is more obscure because it is not seen until the flash takes place, making its presence real.

Static sparks in the operating room may be prevented from igniting these anesthetic vapors by neutralizing potentials or charges of electricity upon those objects or bodies which come into contact with these anesthetic mixtures.

When one shuffles his feet on the carpet and the air is dry, a charge of electricity accumulates upon his body, which is discharged or equalized by contact. Another spark cannot be produced until after similarly shuffling the feet to create another charge. *Hence the simplest method of preventing static sparks is to keep the objects concerned in the administration of combustible mixtures in contact—i. e., the patient, the anesthetist and the inhaler.* This is usually done and accounts for the relative infrequency of fires from static sparks in the operating room. But errors in technic are made and if the conditions are "right" a fire occurs.

An effort has been made at one hospital to make errors impossible by grounding a mosaic floor, consisting of alternate blocks of tile and bronze in one or two rooms and a solid metal floor in another. That is, when one steps upon this floor, the charge on his body flows through a thick wire to the ground. The operating table, apparatus, instruments, anesthetist, surgeons and all are thus grounded or their charges neutralized. There are three possible slips in technic that still require attention even in this system: (1) The patient must be grounded to the table by actually attaching some conductor to the skin of his body, such as a wire or chain; (2) the anesthetist's shoes and others must be conductors and not rubber or dry leather; and (3) grounding particularly of the patient, anesthetist, and inhaler or apparatus must be done *before starting* to administer a combustible mixture. Hence technic is unavoidably essential.

Where does the static electricity come from? *First*, the patient, who is brought to the operating room on a rubber-tired stretcher, rolled over non-conducting floors of tile, cork, rubber or polished wood. *Second*, the anesthetist may bear a charge after rubbing his clothes, walking upon tile, rubbing non-conductors such as leather, glass, rubber, etc.

Third, it may be carried on the operating table or anesthesia apparatus if subjected to friction or rolled about the room. These are the principle sources.

Experiment shows conclusively that water inside an anesthetic apparatus has no effect upon discharging static electricity from the apparatus or preventing an explosion although such claims have been advanced for commercial purposes.

When the air of the room is moist static electricity is discharged into the atmosphere more rapidly than when it is dry, but it is impractical to moisten the air in operating rooms, as too much water is required in arid climates and in active heating seasons during cold weather.

It is very simple and easy to test for or show the presence of static charges capable of producing a spark with an inexpensive pocket electroscope. One may thus determine in a few seconds whether the equipment and personnel of an operating room are free from charges of electricity when its presence may or may not be suspected.

Summary

I. To prevent static sparks:—

(1) Neutralize differences of electrical potentials in one or two ways by:—

(a) Grounding everybody and everything coming into contact with and including the patient before beginning the administration of a combustible anesthetic; or

(b) Contact the anesthetist, inhaler and the patient's face *before* turning the combustible anesthetic into the inhaler and maintain this contact throughout anesthesia.

II. Administer only nitrous oxid-oxygen in the presence of known sources of ignition such as cauteries, *x*-ray and fulguration apparatus and open fires."

Dangers of Explosions in the Use of Acetylene in the Presence of Open Flame

Aside from the danger of static explosions in the use of the newer hydrocarbon gas anesthetics, the following observations by Mr. A. H. Nuckolls, Chemical Engineer of the Carbide and Carbon Co., in answer to inquiries from Drs. A. and J. D. Goldman, are of further pertinent interest and refer particularly to the presence of sources of open flame in dental offices during dental anesthesia.

"We have had occasion before this to study the problem brought out in your inquiry. Our staff has had considerable experience in testing the hazardous properties of gases, and it appears that it is not safe to use ether, ethylene or acetylene for anesthesia in a room in which there is a glowing spark, wire, or open flame.

In case of acetylene, it would hardly be possible to protect open flame effectively by means of screen or other available apparatus. Small percentages of these gases (about 3 per cent by volume) will produce a mixture with air or oxygen which may propagate flame. A little over 3 per cent by volume of ether or acetylene with air will produce an explosion producing a pressure above 100 lb. per sq. in. About 17 per cent of acetylene with air will give an explosion of several hundred pounds per sq. in. From 40-48 per cent of acetylene in oxygen will give an explosion exceeding 500 lb. per sq. in. It is important to note that the danger point begins at about 3 per cent of gas in air or oxygen, and that it is difficult to prevent such a small proportion of gas from getting into the operating room under the conditions employed in operations.

Answering your further question, there is great danger in the presence of a lighted gas radiator on the floor of an operating room, 15 feet from the gas mask.

Stratification of these gases will not take place under the conditions of ordinary dental anesthesia, but convection or air currents cannot be avoided in a room where there is a lighted radiator or other source of heat. The gas will mix with the air by diffusion and convection or air currents. The specific gravity of acetylene is only slightly less than that of air, and it would be possible to have a stream of the gas in flamable proportions reach the flame before the percentage of gas in the entire room reached the danger point, in which case there would be a flash-back to the gas mask, and in the case of administration of acetylene-oxygen there might be a detonation extending to the lungs of the patient.

As to the possibility of the flame consuming explosive gas, thus keeping the concentration in the room constantly below the danger point, while combustion of the gas at the flame would occur, the percentage eliminated would be only a fractional part of the input, under the conditions attending anesthesia."

CONGRESS OF ANESTHETISTS AND CLINIC TOUR ABROAD

Through the courtesy of its Council, members of the Associated Anesthetists of the United States & Canada and the International Anesthesia Research Society are being invited to attend the Congress of Anesthetists to be held in connection with the meeting of the British Medical Association in Nottingham, England, July 20-23, 1926.

In behalf of the British Medical Association, Dr. Alfred Cox, Secretary, announces that the Congress of Anesthetists will be at least Anglo-American, but if at all possible it will be made international in scope. This is a remarkable recognition of the specialty of anesthesia and an evidence of its prestige and development.

It will interest all Associated Anesthetists to learn that Dr. Samuel Johnston, Dean of the specialty in Canada, has been selected by the Council of the British Medical Association to act as President of the Congress. This honor has come to Dr. Johnston not only on account of his standing in the specialty in the United States and Canada but also on account of the esteem in which he is held throughout the far-flung British Empire.

Other Office Bearers for the Congress will be Dr. R. E. Apperly, London, England, Dr. T. B. Gilbart Smith, Nottingham and Dr. F. H. McMechan, Avon Lake, O., Vice-Presidents: Mr. A. M. Webber, Nottingham, Hon. General Secretary for the British Medical Association and Dr. C. Langton Hewer, London, and Dr. I. R. Spark, Nottingham, Hon. Secretaries.

Sessions of the Congress will be held on July 21, 22 and 23 and one of the features will be a Joint Session with the Surgical Section of the British Medical Association.

To realize the possibilities of the 1926 Congress of Anesthetists to the full a Clinic Tour Abroad has been arranged to provide not only a very enjoyable itinerary of sightseeing in the British Isles and on the Continent but also professional and scientific contacts in Ireland, Scotland, England and France, that should prove most desirable and instructive. It is anticipated that there will also be meetings with the Scottish Society of Anesthetists and the Anesthetic Section of the Royal Society of Medicine. If the time and place of the British Dental Association meeting permits, it will also be included in the Tour.

According to present arrangements the Clinic Tour will leave from Quebec on the Canadian Pacific SS. Montroyal, June 18. The Canadian Society of Anesthetists is considering holding its meeting in Toronto, Montreal and Quebec, under the Presidency of Dr. Charles LaRocque, as an advance feature of the Tour. The Tour will enjoy the trip down the St. Lawrence and the pleasant Northern route across the Atlantic, arriving at Liverpool, June 25. Passing through the Welsh Highlands to Holyhead the party crosses the Irish Channel to Kingstown and thence by rail to Dublin for two days, with trips to Killarney its mountain defiles and picturesque lakes as well as Cork and the famous Blarney Stone. Going north Belfast is visited and the Giants' Causeway and the crossing is made by boat to Scotland. Two days are spent in Glasgow followed by the trip through the Trossachs and the country immortalized by Walter Scott. Following sightseeing in Edinburgh and the Firth of Forth the Tour goes on to London for a week.

London and its historical environs will be visited in detail and the party will go to Nottingham through the Shakespeare country. Following the Congress in Nottingham the Tour will cross from Harwich, July 24, to Hook of Holland and will visit Amsterdam and rural Holland as well as crossing the Zuider Zee to the Isle of Marken. The party will pass through Brussels on the way to Cologne and will take the trip on the Rhine and then go on to Frankfort.

In completing the Tour the party will spend a week in Paris, August 3 to 10, and return via Cherbourg on the SS. President Roosevelt, August 11, arriving in New York August 20.

The American Express, 65 Broadway, New York, will be in charge of travel arrangements and an experienced tour manager will be in charge of the party throughout the entire trip. The price of the Tour inclusive from Quebec to New York, including steamship passage at the minimum berth, first class railway travel, good hotels and 3 meals a day and all expenses for sightseeing will be $1,105.00 a person.

To reciprocate the courtesy that is being extended the specialty it is hoped that a very large group of anesthetists will attend the Nottingham Congress and join the Clinic Tour Abroad. The Tour is not limited in its personnel and those anesthetists who go are urged to bring their wives, families and friends along. The cost of the Tour is far more reasonable than any similar trip you could arrange for yourself and as there will be no Congress at home in 1926, you can use the amount usually spent in attending it in going abroad.

Needless to say all concerned in the Congress and Clinic Tour will make every effort to have both meet your expectations. On account of the heavy demand for steamship and hotel accommodations it is imperative for you to make your reservations for the Tour at once in order to secure the desirable locations you will want.

For further information regarding the Congress, professional and scientific contacts, write Dr. F. H. McMechan, Secretary General, Avon Lake, Ohio.

For reservations for the Clinic Tour and full details of the itinerary write, Travel Managers, American Express Travel Department, 65 Broadway, New York, N. Y.

A PECULIAR TYPE OF BURN

The EDITOR of the SUPPLEMENT is indebted to Dr. E. Leslie Burwell, of New Rochelle, N. Y., for calling attention to a peculiar type of burn for which the anesthetic or some other unrecognized source may be unjustly blamed.

In the hospital in which Dr. Burwell works, it is customary to make the field in tonsil operations as sterile as possible and the heads of the patients are draped with a wet bichlorid towel fastened tightly

in place with a clamp. The anesthetist folds a dry sterile towel over both hands so that either can be slipped out to regulate the apparatus or slipped back again to control the head for the surgeon. The faces of the patients are prepared with alcohol.

Recently Dr. Burwell anesthetized two patients for tonsil operations and during both was very much annoyed by the strong odor of cumol, which is used in the catgut tubes, and which he has always found very irritating personally. The anesthesias were uneventful, but the following day the surgeon who had operated told Dr. Burwell that both patients had bad bichlorid burns on their necks.

Dr. Burwell thought that these burns were peculiar but recalled a similar experience some years ago when the nurse had given him the towel for draping in which she had broken the tubes of catgut and Dr. Burwell had burned his own hands and the nose of the patient. On checking back it was found that the nurse had put the catgut towel back on the pile and it was the first one used in the head drapes.

Anesthetists, operators and nurses will do well to remember cumol burns and avoid them.

Society Proceedings

PACIFIC COAST ASSOCIATION OF ANESTHETISTS FOURTH ANNUAL MEETING, YOSEMITE, MAY 18-20, 1925.

The Pacific Coast Association of Anesthetists held its Fourth Annual Meeting in Joint Session with the Section on Anesthesiology of the California Medical Association at the Pillsbury Studio, Yosemite Valley, May 18-20, 1925.

During the Scientific Session the following papers were presented:—

Team Work, (Chairman's Address).—J. Robert Burrows, M.D., San Francisco.

Nitrous Oxid and Regional Anesthesia in Abdominal Surgery.—P. K. Gilman, M.D., San Francisco.

Cardiac Decompensation in Pregnancy.—Karl L. Schaupp, M.D., San Francisco.

Local Anesthesia in Abdominal Surgery.—H. A. L. Ryfkogel, M.D., San Francisco.

Ethylene Anesthesia.—H. A. Thompson, M.D., San Diego.

Medication in Conjunction with Anesthesia. (Presidential Address).—Caroline B. Palmer, M.D., San Francisco.

Evaluation of the Surgical Risk.—F. F. Gundrum, M.D., and J. B. Harris, M.D., Sacramento.

The Handling of Goiter Cases Demanding Surgery. V. R. Mason, M.D., and C. T. Sturgeon, M.D., Los Angeles.

The Psychological Aspect of the Prospective Patient with Special Reference to Pressure Induction.—Frank W. Chandler, D.D.S., Hollywood.

Indications for General Anesthesia in the Extraction of Deciduous Teeth.—Evangaline Jordon, D.D.S., Los Angeles.

Preparation of the Diabetic for Surgery.—Horace J. Hagen, M.D., Santa Barbara.

A Study of the Endocrines in Relation to Operative and Anesthetic Risk.—Clifford A. Wright, M.D., Los Angeles.

Blood Changes in Chronic Alcoholism and their Similarity to those Occurring in Chloroform and Ether Narcosis.—F. R. Nuzum, M.D., Santa Barbara.

Carbon Dioxid Method of De-Etherization.—Ethel Righetti, M.D., San Francisco.

What Is the Present Day Attitude of the Medical Profession Toward the Anesthetist.—Jean Martin, M.D., San Francisco.

Dr. J. Robert Burrows, Chairman, presided during the session of the Section on Anesthesiology and Dr. Caroline B. Palmer, President, presided during the sessions of the Pacific Coast Association of Anesthetists.

During the Executive Sessions Dr. H. A. Thompson, San Diego, was elected Chairman of the Section and Dr. Dorothy Wood, San Francisco, Secretary. The following were elected officers of the Pacific Coast Association of Anesthetists: Dr. R. F. Hastreiter, Los Angeles, President; Dr. Louise Oldenbourg, Berkeley, Vice-President; Dr. Eleanor Seymour, Los Angeles, Secretary-Treasurer; Executive Committee, Dr. Mary Botsford, San Francisco (1928), Dr. R. G. Henderson, Long Beach (1928), Dr. Donald E. Baxter. Glendale (1927), Dr. Wm. W. Hutchinson, Los Angeles (1927), Dr. John S. Lundy, Rochester, Minn. (1926), Dr. Frank Chandler, Hollywood (1926).

The Minutes of the previous meeting were approved as read and the Treasurer's Report accepted as presented. The Treasurer was instructed to remit the usual 50 per cent of the receipts to the central office.

Greetings were received and read from Dr. Wesley Bourne, President-Elect and Dr. F. H. McMechan, Executive Secretary of the Associated Anesthetists of the United States & Canada, and also from Dr. E. I. McKesson.

It was decided to unite Utah with the States of the Pacific Coast area.

The following were elected to membership:—Sylvester Baker, D.D.S., San Francisco; B. F. Coleman, M.D., San Francisco; Esmond A. Childs, M. D., Long Beach; Clarence E. Fox, D.D.S., Bakersfield; Ward Hannah, M.D., Long Beach; M. S. Harmon, M.D., Seattle; George Johnstone, M.D., Los Angeles; Robert Wm. Langley, M.D., Los Angeles; H. H. McCoy, M.D., Long Beach; J. Raymond Martin, M.D., Los Angeles; Josephine Platt, M.D., Pasadena; Orin H. Peak, M.D., Hollywood; H. MacVicker Smith, M.D., Santa Ana; Kenneth B. Turner, M.D., Los Angeles.

The Chairman of the Resolutions Committee, Dr. Louise Oldenbourg presented the following which were adopted as read:—

1. RESOLVED, That an expression of sincere appreciation be sent to the California Medical Association for the many courtesies so graciously extended by its efficient officers to the Pacific Coast Association of Anesthetists.

2. RESOLVED, That an expression of appreciation be forwarded to the secretary of the Los Angeles County Medical Association for courtesy in publishing our announcement and program in the County Bulletin.

3. RESOLVED, That a return wire of acknowledgement and appreciation be sent to Dr. F. H. McMechan, including greetings to the Congress of Anesthetists in Atlantic City.

4. RESOLVED, That an expression of regret be sent to Dr. Mary E. Botsford for her unavoidable absence.

5. RESOLVED, That we commend the recent ruling made by the Council on Medical Education and Hospitals of the A. M. A., to the effect that in all teaching hospitals proper equipment and facilities be provided for the instruction of interns in anesthesiology and that such instruction be given by staff members who are graduate physicians proficient in this special field.

6. RESOLVED, That this Association reiterates its stand deploring the employment of nurse and lay anesthetists, and endorses the attitude of the Council on Medical Education and Hospitals of the A. M. A., favoring only physician anesthetists.

7. RESOLVED, That we urge that all hospitals and anesthetists keep systematic records of all anesthetic administered.

8. RESOLVED, That a demand be made of manufacturers and hospitals to provide pure and fresh anesthetic agents at all times.

ELEANOR SEYMOUR, M.D., *Secretary.*

Abstracts

Abdominal Surgery in Diabetes. D. F. JONES, L. S. McKITTRICK and H. F. ROOT, Boston. *Journal A. M. A.*, September 12, 1925.

Jones, McKittrick and Root are of the opinion that the only additional consideration in deliberate operations on diabetic patients other than would be considered in normal persons is the ability to control the diabetes before operation. In infections, acute and chronic, it is much more important to operate early than in the case of normal persons, and in acute cases the operation is more of an emergency than in the normal. They must be treated as emergency cases because of the difficulty of determining the seriousness of the lesion, and because acute infections quickly lead to serious diabetic conditions. The rule should be to operate first, and at once, in acute infection and treat the diabetes after the operation.

Newer Anesthetics. Editorial. *Lancet*, May 30, 1925.

In an editorial on this subject the *Lancet* states that the ideal anesthetic is still to seek. It is good, therefore, to know that there are scientific men eagerly seeking it. The Combined Committee set up by the Medical Research Council and the Section of Anesthetics of the Royal Society of Medicine has sat for a year or more, and there is reason to hope that besides its valuable work on comparatively unknown agents, its labors will prove fruitful also as regards the standardization and purity of some of the more familiar anesthetic drugs. For it is not injudicious to suspect that even today we may not be getting from the anesthetics with which we are already familiar the best results that they can possibly achieve. It may be that future improvement will lie not in the substitution of other agents for nitrous oxid and for ether, but in the discovery of methods and measures by which the use of these two faithful servants may be purged of the defects which alone rob them of perfection. These are, of course, comparative impotence in the case of the former and after-effects in the case of the latter. If ether were never followed by bronchitis or sickness, and "gas" alone could always produce relaxation, we should hardly need other anesthetics.

The anesthetics (acetylene, propylene, and ethylene) with which Shipway and Pembrey deal in their report suffer from the primary disadvantage of being gaseous. Anesthetics which are gases at ordinary temperature and pressure are, of course, as is familiar in the case of nitrous oxid, inconvenient as regards portability and general handling. It is only the paramount excellence of "gas" in certain directions that compensates for its inconvenience and keeps it in many instances the anesthetic of election. It does not appear that either acetylene or ethylene provides advantages over nitrous oxid that will compensate for their possession of the same defect of inconvenience. Both these gases suffer the additional disadvantages of smell and of easy inflammability. It is true that in this latter respect they are not much worse than ether, for ether, too, cannot be used near an open flame or in contact with the actual cautery. But acetylene and ethylene are rather more easily explosive than ether apart from ignition by flame, and one or two accidents that have occurred in practice show the need for extreme care when these gases are employed in conjunction with nitrous oxid. The practical question of cost is likely also to militate against wide popularity for ethylene. In many respects, however, this gas appears to be a highly satisfactory anesthetic, and it is to be hoped that the efforts of the committee will result in bringing ethylene within easy reach of the anesthetist. At present, except in small quantities, it can hardly be obtained except in America. The large percentages of oxygen which it is found possible and desirable to use in conjunction with ethylene show its potency as an anesthetic agent. It is interesting in this connection to recall the importance attributed to small quantities of ethylene as an impurity in ether by those authorities who declare pure ether to be devoid of anesthetic power.

Propylene has so far been submitted to so little trial that no pronouncement can yet be made on its merits or defects.

The Effects of Nitrous Oxid, Ethylene, Ether and Chloroform on the Contractions of Stomach, Small Intestine and Colon, During General Anesthesia. MILLER and PLANT. *Journal Pharmacology and Experimental Therapeutics*, March, 1925.

Miller and Plant's experiments were done on dogs with permanent fistula of the stomach, the small intestine, or the colon. A bottle-neck fistula was used to enter the stomach, a Thiry-Vella loop of ileum for the small intestine, and an appendicostomy for the colon. In some of the animals the operations had been done from one to two years, and in all cases time was allowed for complete healing before the experiments were performed; so that recent trauma and effects of recovery were not factors in the results. The graphic records of contractions were obtained by introducing through the fistula a catheter on which was tied a sausage-shaped rubber balloon of appropriate size for the viscus being studied. The balloon and catheter were filled with water and connected with a large pear-flask to prevent marked changes in water pressure in the balloon; the upper end of the pear-flask was connected with a Brodie bellows recorder. The record thus obtained is suitable for a comparative study of the changes in tone and in rate and amplitude of the muscular contractions throughout all the stages of anesthesia.

In the surgical stages of ether anesthesia there is practically complete inhibition of contractions of stomach, small intestines, and colon, during which there is a distinct lowering of muscular tone in all three organs. With removal of the anesthetic the return of contractions follows almost exactly the general recovery. As an after-effect the colon shows a marked increase in tone; in the small intestine the increase in tone is not so marked, while the stomach does not show any increase in tone as an after-effect. The production of cyanosis does not cause resumption of the contractions.

The effects of chloroform parallel very closely those of ether. Reëstablishment of contractions is perhaps a little longer delayed in the recovery period.

Ethylene, as ordinarily given to produce light anesthesia, without complete muscular relaxation, causes an increase in the amplitude of the contractions, without change in tone, in all the viscera studied. This is probably due to the asphyxia and light anesthesia, for in deep ethylene anesthesia or after removal of the anesthetic the contractions decrease or rapidly return to normal. Usually about an hour after removal of the anesthetic there is a tendency to diminished activity.

Nitrous oxid and oxygen produce marked increase in activity of stomach, ileum and colon during anesthesia due to asphyxia. With removal of the anesthetic and recovery of the animal there is marked inhibition of contractions in small intestine and colon for an hour or more. The stomach shows less inhibition of contractions than the ileum or colon during recovery.

Poor Surgical Risks. WILLIAM THALHIMER, Milwaukee, Wis. *Journal A. M. A.*, September 12, 1925.

Thalheimer discusses some of the results obtained by laboratory investigations of several types of patients for whom the hazard of a major surgical operation is more serious than for the average patient. This discussion is of laboratory data, their significance and their indications for certain preoperative and postoperative treatment of these patients. Thalhimer pleads not only for the study of these patients with laboratory methods, but especially for the interpretation of laboratory findings by a person who is capable of interpreting them, be he a surgeon, an internist or a laboratory worker. Probably the factors which influence the postoperative course of patients more than any others are those which have to do with renal function. Although an increased blood pressure does not necessarily indicate organic renal disease, it will be found that most patients with this condition show subnormal renal function after operation. Chemical examination of the blood is most important, for evidences of retention of nonprotein nitrogenous substances

(urea, creatinin, etc.) are of great significance. Furthermore, the determination of the quantitative secretion of urea is not given the attention it deserves. Many of these patients who have only a slight degree of anemia, such as would cause no concern in the average patient, should receive transfusions both before and after operation. Next in importance to these factors is the furnishing of adequate carbohydrate nourishment to the patient. This can be accomplished safely by the intravenous route. Instead of the usual physiologic sodium chlorid solution, Thalhimer gives 100 gm. of dextrose a day in the form of either a 5 or a 10 per cent. solution. Sometimes twice this amount is given. By this means, the most important energy-giving constituent of food is supplied and is delivered into the circulation, where it is carried immediately to all the cells for either use or storage. One group of patients present themselves for operation after they have been vomiting for a longer or shorter period of time. These patients are usually in extremely poor condition and have either an acidosis or an alkalosis. The presence of acetone and diacetic acid in the urine (ketonuria) usually indicates an acidosis, but these substances may be present during alkalosis. Appropriate treatment must be given. Impaired physiologic functions of patients demand as much consideration and treatment as their organic diseases. This can be accomplished by developing a physiologic point of view, and using physiologic methods of study and treatment. Finally, this will be possible only by the expenditure of intelligent energy, and when surgeons are sufficiently far sighted to secure at all times the close cooperation with them of internists, laboratory workers, interns and nurses.

Splanchnic Analgesia. Hillman and Apperly. *Lancet*, April 25, 1925.

Hillman and Apperly insure splanchnic analgesia by blocking the path of impulses passing from the viscera, via the celiac ganglia and the great splanchnic nerves, to the central nervous system. This is done by placing a certain amount of one per cent novocain in the path of the splanchnic nerves.

Pannett shows by animal experiments that novocain placed in relation to the mesenteries of the viscera definitely protects the animal from shock produced by handling those viscera. He also shows that the rigidity of the abdominal wall in operations on the abdomen is considerably reduced when the mesenteries of the viscera operated upon are infiltrated with novocain. This proves that the rigidity of the abdominal wall is not entirely due to irritation of the parietal nerves, and, therefore, injection of these nerves alone will not give the same relaxation as if the visceral nerves are blocked as well.

Hillman reports that on giving splanchnic anesthesia to a patient, who was writhing and groaning with pain, due to a perforated gastric ulcer, the pain disappeared as by magic.

In the human subject the upper abdominal viscera are supplied through the great splanchnic nerves, which are derived from the fifth to the ninth or tenth dorsal nerves, and also by the lesser and least splanchnic nerves which run in close proximity. These nerves pass through the crura of the diaphragm and are distributed to the various viscera via the celiac ganglia. For the induction of splanchnic analgesia it is necessary to place novocain in the path of these nerves, and this is done at the level of the first lumbar vertebra.

In order to complete the analgesia for an abdominal operation it is of course necessary to place a block across the paths of the nerves of the abdominal wall. This is done by performing an abdominal field block.

The injection is given under light ether anesthesia, which is continued throughout the operation. The injection is made opposite the first lumbar vertebra. After striking this vertebra and getting the needle in the correct position 1 cm. beyond, 30 cc of a one per cent novocain solution are injected. The needle is then withdrawn and the injection is made on the other side. Aspiration must always be done before injecting, since were this quantity of novocain thrown into the blood stream the result would be fatal. The operator must have a mental picture of where his needle is going.

The most striking phenomenon on watching a case under splanchnic anesthesia is the smallness of the respiratory excursions, as compared with those of a similar case under purely ether anesthesia of as light a depth. There is complete and perfect relaxation of the abdominal wall with a light depth of anesthesia. There is complete absence of sudden straining on the part of the patient when any necessary traction is made. This is especally seen when operating on the gall-bladder and ducts.

As to the advantages to the patient, he receives less anesthetic drug; there is the minimum of shock; there is no fatigue from excessive respiratory excursions; there is no "falling off" of condition after return to the ward, as is so often the case after ether anesthesia; the day following operation the patient is in better condition owing to the absence of shock; owing to the diminution of the amount of the anesthetic drug administered there is less vomiting; there is less liability to chest complications; there appears to be less postoperative pain; some patients who would be considered beyond surgical aid can be given the chance of an operation by means of splanchnic analgesia.

As to the disadvantage, it takes fifteen minutes to anesthesize the patient, and if the operation be a long one the effect of the field block of the abdominal wall may wear off.

There is a distinct fall of blood-pressure after the injection is made, this fall lasting on the average for twenty minutes; after this time the pressure steadily rises throughout the operation, until in about an hour's time it has reached the patient's normal level or even in many cases surpassed it. The fact that there is the same fall whether it is a severe operation or not, and that the pressure is higher at the end than at the beginning of the operation, shows that the fall cannot be attributed to shock.

The authors report on 91 cases of representative major surgery.

Apperly advises practice in the postmortem room before attempting splanchnic block in the living. His technic is as follows: Morphin gr. 1/6 or 1/4, atropin gr. 1/100, given three-quarters of an hour before operation. General anesthesia is induced, either gas-ether or chloroform-ether, and the splanchnic and abdominal field block then done in the anesthetizing room. Directly that is finished, generally occupying about twenty minutes to half an hour, the patient is taken into the theater, and general anesthesia is maintained with ether and oxygen, or chloroform and ether and oxygen. The abdominal incision should not be made until five minutes after the abdominal field block is finished.

It is extremely important to move the patient gently after the injections are made, and to avoid raising the shoulders too high, otherwise the blood-pressure may fall very rapidly.

In private practice the anesthetist, after inducing anesthesia, has to call to his aid the doctor of the case or the surgeon's assistant to maintain a light anesthesia while the regional blocks are done. It is extraordinary how light an anesthesia can be maintained after the first injection. Patients who have been difficult during induction become quite placid, presumably owing to the fall of blood-pressure. The regional blocks cannot be hurried, but to be successful must be slowly and deliberately done. The anesthetist will be aware of the success or otherwise of the splanchnic anesthesia directly the surgeon handles abdominal contents. If the splanchnic block is effective the breathing should neither alter in rhythm or rate, even when considerable traction is put on any of the contents of the upper abdomen.

As a disadvantage of the method postoperative headache and bachache are mentioned. In 91 cases there was only one in which there was postoperative lung complication. There was one death from bronchopneumonia following a partial gastrectomy lasting an hour and a half.

Anesthesia by Nitrous Oxid, Ethylene, Carbon Dioxid and Oxygen for Dental Operations on Children. John S. Lundy, Rochester, Minn. *The Dental Cosmos*, September, 1925.

Young children are, as a rule, poor prospects for gas

anesthesia. They are likewise poor prospects for dental operations without general anesthesia. It has been but a short time since ethylene was first administered to infants with modern apparatus. This anesthetic was found to be more satisfactory than nitrous oxid. Recently, equipment has been obtained and a technic has been evolved which permits of easier administration of gas to children requiring dental operations than was ordinarily possible heretofore.

Very little preanesthetic preparation is necessary other than an empty stomach, rectum and bladder. I employ the technic described here for children less than six years of age. The procedure, which is satisfactory for young children, is obviously even less dangerous when used for adults. The child ordinarily lies on his back; those who are frightened sit upright until asleep. The gas machine, after being carefully tried to see that it is in perfect working order and equipped to carry on an extensive anesthesia, is adjusted so that a mixture of 80 per cent nitrous oxid and 20 per cent oxygen fills the bag. A nose-piece is brought close to the child's face and gradually lowered over the nose. The average child will cry out in such a situation and it is then necessary to proceed determinedly to place the nose-piece over the nose. If the child is ill and has to be anesthetized at intervals for the extraction of a few teeth each time, he makes no particular objection to the induction of anesthesia by nitrous oxid and oxygen after the first or second administration. With children it is more advantageous to begin an anesthetic with an odorless agent than it is with adults.

A very few breaths of the anesthetic (three or four) will make the child dizzy, and the mouth is then covered either with the hand, a wet towel or a piece of gutta-percha. A few additional breaths (three or four) induce very light anesthesia. Carbon dioxid is then added so that it constitutes 5 per cent of the mixture in the bag. This is accomplished with a large bag in a minute and a half. Ethylene is now added to this mixture in gradually increasing volume and at the same time the flow of nitrous oxid is gradually reduced so that over the space of a minute the nitrous oxid has been shut off and the ethylene has been substituted for it. The change from nitrous oxid to ethylene is taking place at the same time that the carbon dioxid is being added. The procedure thus far ordinarily occupies no more than three minutes and in the succeeding two minutes the child will have been brought to the light surgical stage of anesthesia by inhaling its mixture of 75 per cent ethylene, 20 per cent oxygen and 5 per cent carbon dioxid. The gases in the bag should be under a pressure of 8 mm. of mercury which would fill but not distend it. Deep anesthesia is usually not a necessity, especially for children who are ill. The lips should be uncovered at this time. The operator inserts the gag or rubber mouth-prop, packs off the throat and proceeds with the extraction.

The average child gives very little trouble, especially in the hands of an experienced anesthetist; however, the same may be said of any average anesthetic. With younger children, trouble and difficulties must be avoided rather than righted; they are less easily resuscitated than adults. If hurried, the induction period and the second stage of anesthesia are treacherous. By the second stage I mean the brief period of vertigo and diminishing consciousness, which separates the surprise of the face-mask (induction period) from the black silence of the third (surgical) stage. A child should not be rushed through any stage. I have previously pointed out that respiration occasionally halts in the second stage of ethylene-oxygen anesthesia. The character of the respiration of a child under nitrous oxid and oxygen is very uncertain; fortunately, with ethylene and oxygen it is more reliable. The breathing is uncertain enough in any gas anesthesia in children, so that one must use carbon dioxid throughout in order to feel as safe as possible. There are periods during anesthesia when the quantity of carbon dioxid supplied by rebreathing is not sufficient to control respiration. However, respiration can be controlled in most cases by administering carbon dioxid through a machine. The proper quantities of carbon dioxid are thereby supplied at the proper times.

The use of carbon dioxid must be understood for purposes of safety. Never more than 10 per cent should be used; that is, with the Gwathmey type of machine, no more than two holes of carbon dioxid should be used, and with the new four-control machine made by Heidbrink, no more than fifteen gallons an hour. Carbon dioxid in strengths

PROGRESSIVE RESPIRATORY FAILURE* (Onset may be sudden or slow)

Stage	Degree	Pupils	Skin and blood	Respiration	Duration, seconds	Treatment	Remarks
A	1	Large	Blue	Shallow or irregular	10	Turn patient's head sidewise, raise the jaw.	Often sufficient if done early
B	2	Widely dilated, no reaction to light	Black	Just stopped	5	Stop the ethylene and nitrous oxid, continue the oxygen and carbon dioxid	Nothing more may be necessary
C	3	Same	Black	None	5	Moderately distend the breathing bag with oxygen, with the mask still in place on the nose	To force the oxygen in
D	4	Same	Black	None	10	Remove mask, empty mouth nose and throat. Lower head quickly	To remove vomitus, blood, foreign bodies, and so forth
E	4	Same	Blue	None	For as long as necessary	Artificial respiration, return mask to nose. Oxygen in bag	To draw oxygen in
F	1	Large	Red	Irregular		After the first voluntary breath add 5 per cent of carbon dioxid to the oxygen	To stimulate respiratory center
G		Normal and reacts to light	Pink	Slow		Administer this mixture until the patient's condition is satisfactory	To restore to normal
H						Resume anesthetic gradually	

*Under this title are included all grades of failure, from the ordinary accidents of respiration which limit aëration of the blood, up to and including paralysis of the respiratory center.

of more than 10 per cent often produces coughing and choking, and in very strong concentrations (25 to 100 per cent) inhibits respiration. It is obvious that too much carbon dioxid is worse than none at all. Five to ten gallons an hour are usually sufficient. It should usually amount to about 5 per cent or less. Respiration is increased in depth by carbon dioxid. In infants this is particularly welcome, because respiration is ordinarily very rapid and shallow. Deep respirations tend, automatically, to slow the rate. The stimulation of the respiratory center by carbon dioxid so deepens the respiration that loose teeth, blood and blood clots may be aspirated if they are not kept out of the throat. I believe the horizontal position to be the best one for children.

During the anesthesia, the blood should vary from pink to deep red, but should never be black; the skin should remain pink. The pupil is not always a reliable guide. Anesthesia is too deep, however, if the pupil is widely dilated and does not react to light; it is ordinarily of normal size or slightly dilated and reacts promptly to light. The motility of the eyeball is important. In the ideal stage of anesthesia, the light surgical stage, the eyeball, which has previously been moving freely, slows down or almost stops. One should avoid the deeper stage wherein the eyeball is turned, fixed and staring, like a combination of squint with exophthalmos.

When ethylene and oxygen are given ideally the respiration simulates that of normal sleep. Snoring and respiratory deepening are the rule when carbon dioxid is added.

The recovery of the child from gas anesthesia is characteristically smooth if the stomach has been emptied previously. A recently eaten meal usually causes postanesthetic vomiting. The mask should be lifted from the patient's nose, after which consciousness will ordinarily return quietly if he be not disturbed or roughly aroused. After a short rest the patient may usually be taken home.

I would be most emphatic in sounding a warning that a gas anesthetic of any type for children is one of the most delicate of anesthetics. Its administration should never be attempted by one who is not familiar with gas anesthesia. Nor is it always advisable for one accustomed to inducing gas anesthesia in adults to attempt to induce it in children. It certainly should not be attempted by the operator alone; there should be an anesthetist in attendance. The color of the patient's skin and the type of respiration must be watched constantly. I have pointed out previously that no two children will respond alike to a gas anesthetic from a respiratory standpoint. There is practically no warning from a small child as the danger line is approached. Therefore the greatest care should be exercised in anesthetizing young children, and the younger they are the greater the care required.

Insufficient aëration of the blood results from failure of respiratory function. This may be caused by obstruction of the respiratory passage, shallow respiratory movements or lack of respiratory effort. Regardless of the cause, the effect is the same. The onset of the symptoms may be slow or sudden but they become progressively worse. Gas anesthetics are rapid in action and the treatment of accidents must be rapid. The tabulated outline of emergency measures may be helpful because at such times there must be no confusion of thought or action, (see Chart).

Clinical Observations on the Use of Magnesium Sulphate with Morphin-Hyoscin in Labor. Paddock. *Journal Missouri State Medical Association*, June, 1925.

Paddock states that one objectionable feature in the morphin-hyoscin seminarcosis is the restlessness seen in some cases. This feature he has attempted to eliminate by the use of magnesium sulphate solution administered during the course of the seminarcosis. Since the method of producing morphin-hyoscin seminarcosis in his hands has been so satisfactory for a number of years, no marked deviation from the usual mode of administration was considered advisable.

Using his regular method as a back-ground, he selected a dosage of magnesium sulphate which has varied with the individual. The procedure is as follows: Patients considered suitable for this conduct of labor were given as an initial dose 1/6 grain of morphin sulphate with 1/130 grain of hyoscin hydrobromid. After the initial dose the patient is requested to be as quiet as possible and to refrain from conversation with those attending her. All extraneous stimuli, such as bright light, sounds, and manipulation, are done away with at this time. Forty-five minutes after the first injection, a second injection of hyoscin is given. By this time the patient is usually quite drowsy and sleeps at intervals between contractions. Forty-five minutes after the second injection the first dose of magnesium sulphate is given.

The preparation which he has used is a 25 per cent aqueous solution prepared in ampoules. The dosage used in his first cases was quite small because he wishes to proceed cautiously and give a minimum dose to produce the desired effect. After a number of results were obtained he felt that the optimum dose is 1.3 cc of the solution per 10 kilograms of body weight. For example, a patient weighing 140 pounds would receive 8.2 cc. The solution in all cases has been given intramuscularly by means of a long needle with small bore.

The magnesium sulphate solution is repeated if necessary after an interval of two to five hours, depending upon the restlessness of the patient. The seminarcosis is continued throughout the subsequent course of labor by the administration of small doses of hyoscin hydrobromid. These subsequent doses are approximately 1/260 of a grain and are repeated as necessary, but not more frequently than one and a half hours apart.

The method outlined has been used in thirty-three cases with results which are in general quite satisfactory. The cases were carefully selected in order to rule out any unfavorable results from other causes. With the exception of three cases all of the patients were primiparas. The other three had all had miscarriages of short gestation. The largest quantity of magnesium sulphate solution given any one patient during labor was 19.4 cc, and the smallest was 3 cc. The longest labor in the series was 25.15 hours, and the shortest was five hours.

Being entirely open-minded on the subject, Paddock has worked up and analyzed this series of cases. He has studied them from a very critical point of view. From the patients' standpoint the amnesia and analgesia were good in twenty-eight cases, fair in three, and poor in one case only. From the standpoint of what he wished to accomplish in addition to the amnesia, he says that the results were satisfactory in all but two cases, and in the majority of cases, eighteen in number, the results were extremely favorable.

All of the children were born living and left the hospital in good condition. In only three of the cases was resuscitation of any kind necessary. In one of the cases it was definitely necessary because of a very markedly constricted umbilical cord. Four of the mothers were 17 years of age or less, and three were over 34 years of age.

Their cases were watched carefully following delivery to see if any latent unfavorable effects could be attributed to the use of magnesium sulphate. There were no marked complications during or after labor that he could attribute to the use of magnesium sulphate. In general the results were quite satisfactory. In almost every single case restlessness was an unimportant feature, or was entirely eliminated. Of course, in the majority of cases where morphin-hyoscin is used alone, the restlessness of the patient is not considered troublesome enough to make the method unsatisfactory or unsuitable for use, but by the addition of magnesium sulphate to the morphin-hyoscin method the restlessness is almost entirely eliminated.

From the standpoint of the patient the results obtained may best be illustrated by describing the course of a typical case. Following the technic as outlined, the patient is given the initial dose of morphin-hyoscin. Some thirty minutes later the patient will state that the pains are less severe and she is slightly drowsy. Some flushing of the skin is noted. Shortly after the second injection (hyoscin) the patient is noted to sleep between contractions. At this time the patient is more indifferent to surroundings and answers questions rather indifferently. By the time of the third injection the patient is usually in a state of amnesia, coördination is poor, and she may or may not answer questions when aroused, and is irrational in speech. At the time of

the magnesium sulphate injection the patient is usually quiet and offers little resistance to the intramuscular injection. During the balance of the labor the amnesia is continued by injections of hyoscin as indicated, magnesium sulphate being repeated in some cases at two-to five-hour intervals. The delivery is carried out as in any case, depending upon the indications and the choice of procedure at the discretion of the operator.

The patient usually sleeps several hours after delivery if not disturbed. This sleep following delivery is ideal, for on awakening the patient is fully conscious and free from the effects of the seminarcosis and amnesia. On interviewing patients some twelve to twenty-four hours after delivery, the experiences of the patient are somewhat as follows: Some relief of pain was experienced after the first injection. Shortly after the second injection the pains subsided and nothing else was remembered. Very few patients remember more than two injections. Conception of the time elapsing during the course of labor is lost. Some events after the second injection are remembered in a few cases.

As already stated, his results in this series of cases have been conducted with the idea of giving the method a fair trial. He has kept well within the limit of safety in his dosage of magnesium sulphate, the dose being many times smaller than the anesthetic dose. His results have been encouraging and in the majority of cases very satisfactory. He believes that the method has given results highly in favor of the procedure and of distinct value in the conduct of safe, painless obstetrics.

Paddock is not as yet recommending this procedure in the first and second stages of labor in preference to morphin-hyoscin seminarcosis as carried out by the Gauss method, nor does he recommend its use in the present modified way. He feels, however, with further experience that the procedure should necessitate the use of considerably less hyoscin, as well as doing away with the restlessness of the patient during pains in most instances. He therefore feels justified in carrying the procedure further in hopes of developing a more ideal method from every standpoint.

The Behavior of Ether in the Body. H. W. HAGGARD, New Haven, Conn. Abstract of Address presented during the Fourth Annual Congress of Anesthetists, 1925.

Surgical anesthesia represents one of the triumphs of experimental medicine. The introduction of anesthesia became widespread so rapidly, and its practice has become so common, that the study of the scientific aspects of the procedure has scarcely kept pace with the growing use of anesthetic substances in medicine. Many novelties have been introduced, and the technic of administration has experienced almost innumerable innovations since the middle of the last century. Yet there is much about the pharmacology of the anesthetics that still demands explanation. After all, the success of anesthesia depends largely on the fact that some body cells are more susceptible than others to certain drugs. As Lee expressed the situation, an anesthetic such as ether or chloroform is a depressant of living substance: when its administration is continued, it diminishes and may ultimately put a stop to vital action and cause death. It acts on all kinds of protoplasm and all varieties of cells and tissues, but in the early stages of its administration its action is more obvious on the brain than on other parts. Within the brain, it depresses first those cells whose activities are accompanied by consciousness and therefore by the recognition of pain. Next in order of paralysis comes the spinal cord, which contains the central nervous mechanism of most of our bodily movements. And lastly comes the medulla oblongata, in which lies, among other important nervous centers, the center that maintains respiration. The successful administration of an anesthetic for a surgical operation demands that just so much of the drug be given as is required by the brain cells and the cells of the spinal cord to banish consciousness and to produce relaxation of the muscles. With any amount beyond this, anesthesia approaches the danger point of stopping the breathing or the heart.

Ether still enjoys the largest popularity among the anesthetics, in this country at least; hence, all information about its properties will be eagerly sought by those who apply it in their professional work. The fate of ether, like that of all anesthetics in the body, is of foremost importance. The investigations of Haggard, the Sheffied Scientific School of Yale University have demonstrated that ether is not destroyed or utilized by the body. It is all excreted unchanged. Approximately 90 per cent. of ether absorbed can be recovered in the expired air after the cessation of the administration. A certain small amount of ether may be eliminated through the skin, in the perspiration, and in the urine. The great mass of eliminated ether, however, finds its way into the expired air. The elimination of ether through exposed serous surfaces plays an unimportant part in the general elimination of ether. The solubility of this anesthetic in blood and in water is about the same.

According to further studies by Haggard, under comparable conditions of respiration and circulation, the rate at which ether is absorbed is in direct proportion to the concentration inhaled. The time required to reach full saturation or any given percentage of saturation of the body is the same for all ether concentrations. On the other hand, the time required to absorb any given amount or mass of ether under inhalation of different concentrations is disproportionately rapid for the higher concentrations. The rate at which ether is absorbed or eliminated varies nearly, but not quite, in exact proportion to the volume of air breathed. The rate of blood flow has very little influence on the rate of ether absorption or elimination. The relatively great influence exerted by the volume of air breathed is occasioned by the high solubility coefficient of ether. The reverse relation exists with comparatively insoluble gases.

The recent studies have made clear also that the ether concentration reached in the central nervous system, not that in the body as a whole, is the determining factor in the anesthetic action of ether. The central nervous system has a much larger blood flow than have other tissues. According to Haggard, when ether is absorbed it is distributed between a small bulk on which it has a physiologic action, the central nervous system, and a large bulk, the rest of the body, on which it has virtually no action. The body thus acts through its large capacity for ether as an enormous buffer to delay both induction of anesthesia and, later, the elimination of the anesthetic. Because of its large blood supply, the brain rapidly approaches saturation at the tension of ether in the arterial blood. The ether content of the blood from the internal jugular is an index of brain saturation, and runs only a little below that of the arterial blood. The mixed venous blood of the right heart is an index of general body saturation. It approaches the arterial level very slowly. It is thus that the buffer referred to above retards the induction of anesthesia. The ether content of the arterial blood is the critical factor in determining the degree of anesthesia at the time. This factor bears no immediate relation to the total amount of ether that has been absorbed by the body.

In all considerations of the use of ether, it should be borne in mind that its vapor is an irritant. As Haggard has reminded us, ether vapor elicits from the respiratory tract the response common to all respired irritants; it causes reflex coughing by laryngeal irritation and, under suitable conditions, inhibition of respiration; it produces increased mucous flow through the stimulation of the glands of the respiratory mucosa. Its irritant action on the cornea and conjunctiva is so well known as to require no comment. In order to induce rapid anesthesia, it has become customary to administer a concentration of ether vapor much higher than that necessary to maintain fully developed anesthesia. The objectionable features of such a procedure, which always invites irritant action, can be averted in large measure by lowering the concentration of ether used but increasing the volume of breathing through admixture with carbon dioxid, a respiratory stimulant. The same gas, used in small amounts, will subsequently facilitate elimination of ether when it is desired to terminate the anesthesia. The Yale investigators assure us that it is entirely feasible by means of inhalation of dilute carbon dioxid to produce a fivefold increase in the volume of breathing. It remains to be seen to what extent the fundamental features here emphasized will find a useful place in the current practice of anesthesia.